Vol. 10, No. 4
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# Energy Research Abstracts

Abstracts 6254-8104

Office of Scientific & Technical Information
UNITED STATES DEPARTMENT OF ENERGY

# CURRENT AWARENESS PUBLICATIONS ON ENERGY

To provide complete coverage of literature related to major Department programs, announcement publications that are comprehensive in their coverage of certain energy fields are issued regularly. All information in these publications, plus additional backup information, is included in the Energy Data Base of the Office of Scientific and Technical Information; all references are also available for machine searching via the on-line retrieval system, DOE/RECON, and the commercial on-line retrieval systems. Descriptions of these current awareness publications, which are supported either directly or indirectly by the DOE, appear below. Department of Energy components may receive the listed publications free from the Office of Scientific and Technical Information, U. S. Department of Energy, P. O. Box 62, Oak Ridge, TN 37831. Telephone (615) 576-1301; FTS 626-1301.

## PUBLICATIONS OF THE OFFICE OF SCIENTIFIC AND TECHNICAL INFORMATION

***Energy Abstracts for Policy Analysis (EAPA)***

A monthly abstract journal devoted to the analysis of energy research, conservation, and policy. Scope and coverage are limited to substantive articles or reports and emphasize legislative, regulatory, and other legal aspects, as well as social, economic, and environmental impacts. *EAPA* is available from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The annual subscription price is $72.00 for domestic (North America) or $90.00 for foreign (outside North America) subscribers; a single issue is $5.00 or $6.25, respectively.

***Energy Research Abstracts (ERA)***

A comprehensive semimonthly abstract journal devoted to all areas of energy-related information produced by the Department of Energy, other U. S. government organizations, and foreign governments. *ERA* is available from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The annual subscription price for the 24 issues is $146.00 for domestic (North America) subscribers or $182.50 for foreign (outside North America) subscribers. A single issue is $14.00 or $17.50, respectively.

***DOE Patents Available for Licensing (PAL)***

DOE is prepared to grant exclusive or nonexclusive, revocable licenses under DOE-owned U. S. patents and patent applications: this semiannual publication provides abstracting and indexing coverage of this literature. *PAL* is available on subscription (use PB85-946800) from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161. The annual subscription price is $14.00 for domestic (North America) or $28.00 for foreign (outside North America); a single issue is $7.00 or $14.00, respectively.

***Energy Meetings (EM)***

A monthly listing of conferences, symposia, workshops, etc., pertaining to DOE's programmatic interests. *EM* is available on subscription (use PB85-901500) from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161. The annual subscription price is $40.00 for domestic subscribers and $80.00 for subscribers outside the North American continent; a single issue is $5.00 and $10.00, respectively.

The following monthly update journals are available to the public on subscription from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161; use the identifying order number (PB- No.) when subscribing. The annual subscription price (12 issues plus cumulative index) is $75.00 for domestic (North America) and $150.00 for foreign (outside North America) subscribers; a single issue is $7.00 and $14.00, respectively.

***Current Energy Patents (CEP)*–PB85-902800**

Devoted to international patent literature, including patent applications, on any aspect of energy production, conservation, and utilization.

***Energy and the Environment (EAE)*–PB85-914900**

Devoted to information on the impacts of energy-related activities and radioactive and nonradioactive pollutants on the environment.

***Fossil Energy Update (FEU)*–PB85-914600**

Devoted to information on the exploration, development, processing, and use of fossil fuels.

***Fusion Energy Update (CFU)*–PB85-915300**

Devoted to information on controlled thermonuclear fusion, including plasma and fuel research and power plant engineering and conceptual design studies.

***Solar Energy Update (SEU)*–PB85-914500**

Devoted to information on the utilization of solar energy, including biomass and tidal and wind power.

The following semimonthly bulletins are also available from the National Technical Information Service. The annual subscription rate for one volume (calendar) year (24 issues; no indexes) is $40.00 for domestic (North America) and $80.00 for foreign (outside North America) subscribers; use the identifying order number (PB- No.) when subscribing.

***Acid Precipitation (APC)*–PB85-901000**

Covers all aspects of acid precipitation, including effects and possible control measures.

***Buildings Energy Conservation (BEC)*–PB85-900700**

Covers worldwide information on the technology required for energy conservation in buildings of all types.

***Coal-Based Synfuels (CBS)*–PB85-901400**

Covers all aspects of conversion of coal into gaseous or liquid fuels.

***Coal Preparation and Pollution Control (CPC)*–PB85-900600**

Covers all aspects of coal preparation and cleaning and reducing pollution from its direct combustion.

***Direct Energy Conversion (DEC)*–PB85-946600**

Covers the following areas: photovoltaics, magnetohydrodynamics, electrohydrodynamics, thermoelectrics, thermionics, and fuel cells.

***Energy from Biomass (EFB)*–PB85-900600**

Covers worldwide information on all aspects of biomass production, conversion, and utilization for energy.

***Geothermal Energy Technology (GET)*–PB85-914700**

Covers information on the exploration, development, and utilization of geothermal resources.

***Heavy-Ion Reactions (HIR)*–(PB85-900500)**

Covers all aspects of heavy-ion ($A > 4$) reactions.

***Laser Research (LAR)*–PB85-901100**

Covers all aspects of laser research and development, but excludes applications.

***Nuclear Fuel Cycle (NFC)*–PB85-913400**

Covers all aspects of the nuclear fuel cycle, both front end and back end.

***Nuclear Reactor Safety (NRS)*–PB85-913500**

Covers the safety aspects of accident analysis, safety systems, radiation protection, decommissioning and dismantling, and security measures.

***Radioactive Waste Management (RWM)*–PB85-902900**

Covers the management aspects of transport and storage, waste processing, waste disposal, waste storage, radioactive effluents, and shipping containers.

***Solar Thermal Energy Technology (STT)*–PB85-901200**

Covers research in materials, concentrators/receivers, salinity gradients, etc., for development of efficient and reliable solar thermal conversion systems.

***Unconventional Petroleum (UCP)*–PB85-901300**

Covers all aspects of secondary and tertiary recovery of petroleum and of oil shales and tar sands.

## INTERNATIONAL ENERGY PUBLICATIONS

The Office of Scientific and Technical Information (OSTI) cooperates in the publication of international abstract journals with the following: (1) International Atomic Energy Agency, International Nuclear Information System, Vienna, Austria, for *Atomindex;* (2) International Energy Agency, Biomass Conversion Technical Information Service, Dublin, Ireland, for *Biomass Abstracts;* and (3) International Energy Agency, IEA Coal Research, London, England, for *Coal Abstracts.* In each case, the cognizant foreign agency provides the non-U. S. information to OSTI for inclusion in the Energy Data Base; in turn, OSTI provides the U. S. information for input into the respective journal.

***Atomindex***

A semimonthly abstract journal providing worldwide coverage of information on nuclear science and technology. *Atomindex* is available by subscription from UNIPUB, 345 Park Avenue South, New York, NY 10010. The cost of an annual subscription, 24 semimonthly issues and semiannual and annual cumulative indexes, is $290.

***Biomass Abstracts***

A bimonthly abstract journal with comprehensive coverage of information in any step involved in the eventual conversion of biomass to energy. *Biomass Abstracts* is available free to Department of Energy components and contractors from OSTI. Non-DOE organizations may obtain *Biomass Abstracts* from Biomass Conversion Technical Information Service, Institute for Industrial Research and Standards, Ballymun Road, Dublin 9, Ireland, for 42 IR pounds per year. Make checks payable to the Institute.

***Coal Abstracts***

A monthly abstract journal providing comprehensive worldwide coverage of information in the field of coal science and technology. *Coal Abstracts* is available to Department of Energy components and contractors from OSTI. Non-DOE organizations may obtain *Coal Abstracts* from IEA Coal Research, Technical Information Service, 14-15 Lower Grosvenor Place, London SW1W 0EX, England, for 100 pounds sterling per year.

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# ENERGY RESEARCH ABSTRACTS

## ABOUT THE OFFICE OF SCIENTIFIC AND TECHNICAL INFORMATION

The Office of Scientific and Technical Information (OSTI) in Oak Ridge, Tennessee, has been the national center for scientific and technical information for the Department of Energy (DOE) and its predecessor agencies since 1946. In developing and managing DOE's technical information program, OSTI places under bibliographic control not only DOE-originated information but also worldwide literature on scientific and technical advances in the energy field and announces the source and availability of this information. Whereas the literature of science is emphasized, coverage is extended to DOE programmatic, socioeconomic, environmental, legislative/regulatory, energy analysis, and policy-related areas. To accomplish this mission, OSTI builds and maintains computerized energy-information data bases and disseminates this information via computerized retrieval systems and announcement publications such as abstracting journals, bibliographies, and update journals. Direct access to OSTI's most comprehensive data base, the Energy Data Base, is available to the public through commercial on-line bibliographic retrieval systems. The Energy Data Base and many of OSTI's energy-related data bases are available to DOE offices and contractors and to other government agencies via DOE/RECON, the Department's on-line information retrieval system. The Office of Scientific and Technical Information has developed and maintains systems to record and communicate energy-related research-in-progress information, to maintain a register of DOE public communications publications, to track research report deliverables from DOE contractors, and to test and make available DOE-funded computer software programs with scientific and management applications; OSTI also serves as adviser for special publication needs of the Department. To effectively manage DOE's technical information resources, OSTI's program is one of continual development and evaluation of new information products, systems, and technologies.

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## ABOUT *ENERGY RESEARCH ABSTRACTS*

*Energy Research Abstracts (ERA)* provides abstracting and indexing coverage of all scientific and technical reports, journal articles, conference papers and proceedings, books, patents, theses, and monographs originated by the U. S. Department of Energy, its laboratories, energy centers and contractors. *ERA* also covers other energy information prepared *in report form* by federal and state government organizations, foreign governments, and domestic and foreign universities and research organizations. The user should remain aware that *ERA* coverage of non-report literature is limited to that generated by Department of Energy activity.

*ERA* is comprehensive in its subject scope, encompassing the DOE's research, development, demonstration, and technological programs resulting from its broad charter for energy sources, supplies, safety, environmental impacts, and regulation.

*ERA* is available on an exchange basis to universities, research institutions, industrial firms, and publishers of scientific information. Inquiries should be directed to the Office of Scientific and Technical Information, P. O. Box 62, Oak Ridge, TN 37831.

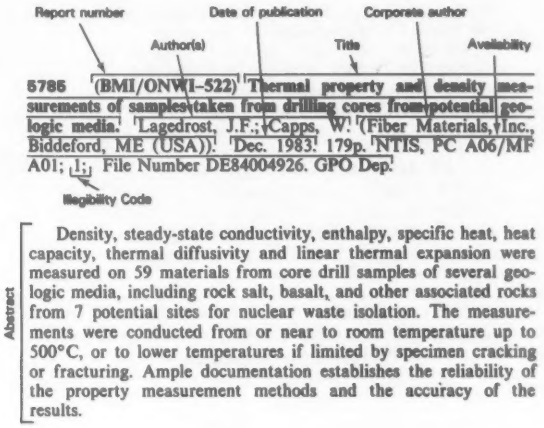
*ERA* is available to the public on a subscription basis from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The subscription rate for the 24 semimonthly issues is $146.00 for domestic subscribers and $182.50 for foreign subscribers. A single issue costs $14.00 (domestic) or $17.50 (foreign). The cumulative indexes will be available in printed form from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402, and in microfiche form from the National Technical Information Service, U. S. Department of Commerce, Springfield, VA 22161, and from Engineered Systems, P. O. Box 866, Oak Ridge, TN 37831.

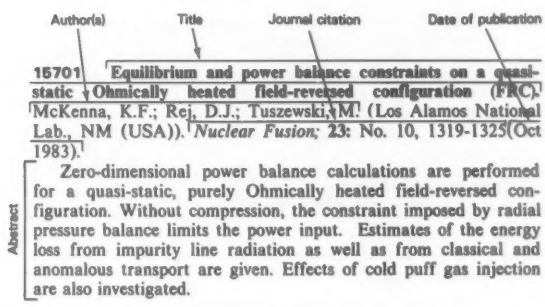
**Office of Scientific and Technical Information**
**United States Department of Energy, P. O. Box 62, Oak Ridge, TN 37831**

# HOW TO USE *ENERGY RESEARCH ABSTRACTS*

## ABSTRACTS IN *ENERGY RESEARCH ABSTRACTS*

The principal elements of abstract entries for a typical research and development report and a typical technical journal article are illustrated below.


Report number
Date of publication
Corporate author
Author(s)
Title
Availability
5785 (BMI/ONWI-522) Thermal property and density measurements of samples taken from drilling cores from potential geologic media. Lagedrost, J.F.; Capps, W. (Fiber Materials, Inc., Biddeford, ME (USA)). Dec. 1983. 179p. NTIS, PC A06/MF A01; I.; File Number DE84004926. GPO Dep.
Illegibility Code
Abstract
Density, steady-state conductivity, enthalpy, specific heat, heat capacity, thermal diffusivity and linear thermal expansion were measured on 59 materials from core drill samples of several geologic media, including rock salt, basalt, and other associated rocks from 7 potential sites for nuclear waste isolation. The measurements were conducted from or near to room temperature up to 500°C, or to lower temperatures if limited by specimen cracking or fracturing. Ample documentation establishes the reliability of the property measurement methods and the accuracy of the results.


Author(s)
Title
Journal citation
Date of publication
15701 Equilibrium and power balance constraints on a quasi-static, Ohmically heated field-reversed configuration (FRC). McKenna, K.F.; Rej, D.J.; Tuszewski, M. (Los Alamos National Lab., NM (USA)). Nuclear Fusion; 23: No. 10, 1319-1325 (Oct 1983).
Abstract
Zero-dimensional power balance calculations are performed for a quasi-static, purely Ohmically heated field-reversed configuration. Without compression, the constraint imposed by radial pressure balance limits the power input. Estimates of the energy loss from impurity line radiation as well as from classical and anomalous transport are given. Effects of cold puff gas injection are also investigated.

## INDEXES TO *ENERGY RESEARCH ABSTRACTS*

Five indexes are provided for approaching the contents of each issue of *Energy Research Abstracts (ERA)*. Each index is preceded by an introduction that details the organization of the index and the principles by which it was compiled. The reader is referred to these introductions for information not found in the index examples that follow.

### • Corporate Author Index

Technical report literature is indexed using the name of the organization or institution responsible for the issuance of the report.

5785 (BMI/ONWI-522) **Thermal property and density measurements of samples taken from drilling cores from potential geologic media.** Lagedrost, J.F.; Capps, W. **(Fiber Materials, Inc., Biddeford, ME (USA)).** Dec. 1983. 179p. NTIS File Number DE84004926. GPO Dep.

is indexed as:

**Fiber Materials, Inc., Biddeford, ME (USA)**

### • Personal Author Index

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

**Capps, W.,** *See* Lagedrost, J. F.
**Lagedrost, J.F.,** Thermal property and density measurements of samples taken from drilling cores from potential geologic media, 9:5785 (R;US)
**McKenna, K.F.,** Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC), 9:15701 (J;US)
**Rej, D.J.,** *See* McKenna, K.F.
**Tuszewski, M.,** *See* McKenna, K.F.

### • Subject Index

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles, informative phrases, or both specific to these entries are arranged alphabetically under the entries.

**SALT DEPOSITS**
**Density**
Thermal property and density measurements of samples taken from drilling cores from potential geologic media, 9:5785 (R;US)
**REVERSED-FIELD PINCH**
**Energy Balance**
Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC), 9:15701 (J;AT)

### • Contract Number Index

DOE technical report literature is indexed using contract numbers. This index contains the contract number with corresponding abstract and report numbers.

**AC06-76RL01830** **Fiber Materials, Inc., Biddeford, ME (USA)** 9:5785 BMI/ONWI-522

### • Report Number Index

Technical report literature is also indexed using report numbers. This index includes information on where individual reports may be obtained. Patents and conference papers are indexed here as a matter of convenience. When a report is supplied under a File Number, that number is included in the availability statement. A file number–report number correlation is included for convenience.

**BMI/ONWI-522** 9:5785 NTIS, PC A09/MF A01. File Number DE84004926, Distribution Category MN-70

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Much of the information is provided by (1) bilateral exchange agreements with foreign organizations and (2) exchange agreements or contracts with other U. S. government agencies, private firms, or institutions.

**Foreign Sources**

CEA Centre d'Etudes de Saclay
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Fachinformationszentrum
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Karlsruhe, Federal Republic of Germany

IEA Biomass Conversion Service
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IEA Coal Research
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National Library of Medicine
Bethesda, MD

Plenum Publishing Corporation
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Communication concerning the editorial policy and content of *Energy Research Abstracts* should be addressed to the Editor, *Energy Research Abstracts,* Office of Scientific and Technical Information, P. O. Box 62, Oak Ridge, TN 37831.

# SUBJECT CONTENTS (NUMERICAL LISTING)

Six-digit subject category numbers are used in the storage, retrieval, and manipulation of bibliographic information entered into DOE's computerized bibliographic information system. The six-digit category numbers are utilized as if they were three pairs of two-digit numbers, the first two pairs being used to arrange the abstract content of *Energy Research Abstracts*. The following listing includes the totality of the 40 first-level and 293 second-level subject categories used. Because each issue of *ERA* announces only those documents becoming available during a semimonthly period, some subject categories may not be represented in every issue. The complete subject category scheme with scope definitions and limitations is available as DOE/TIC-4584-R5 from NTIS for $9.50.


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**51 ENVIRONMENTAL SCIENCES, TERRESTRIAL**
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# ENERGY RESEARCH ABSTRACTS

## 01 COAL AND COAL PRODUCTS

6254 **(NP—5770096) Engler-Bunte-Institute in the year of 1983.** Hedden, K.; Griesbaum, K.; Leuckel, W.; Sontheimer, H. (Karlsruhe Univ. (TH) (Germany, F.R.). Engler-Bunte-Inst.). 1984. 108p. (In German). NTIS (US Sales Only), PC A06/MF A01. File Number DE85770096.

The book 'The Institute in the year 1983' of the Engler-Bunte-Institute of the University of Karlsruhe (TH) contains reports of scientific works and works in the field of application of the technical science in the report year. It is also reported about the teaching, lectures and papers. The works are concerned with the fields of chemistry and technology of gas, petroleum and coal, petrochemistry and organic technology, combustion technology and water chemistry. The works in the field of application of the technical science are carried out in cooperation with companies of gas and water supply.

### 0104 Processing

*REFER ALSO TO CITATION(S) 0104006294, 6301, 6310, 6346, 6347, 7522, 7522*

6255 **(DOE/ER/10914—T2) Direct liquefaction of peat and lignite to BTX-type liquid fuel. Final technical report, June 1, 1981-August 31, 1984.** Cody, R.J.; Heneghan, E.P.; Houmere, D.M.; Trantolo, D.J. (Dynatech R/D Co., Cambridge, MA (USA)). 26 Oct 1984. Contract AC02-81ER10914. 114p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE85003704.

This report relates the work on the experimental research and development program for the direct liquefaction of peat and lignite to a BTX-type liquid fuel. Both the BTX-type and alcohol fuel processes have as their major feature an alkaline hydrolysis pretreatment of the peat and lignite. It was proposed to investigate the susceptibility of these organics to further chemical and biological treatment for production of BTX-type and alcohol fuels, respectively. The work directed toward the production of BTX-type fuel is detailed in this report. The experimental program involved laboratory scale work in two process steps: (1) alkaline hydrolysis for pretreatment; and (2) catalytic decarboxylation for conversion of pretreatment products to BTX-type fuel. Both of these areas were approached independently to establish the technical feasibility and to determine process operating conditions and yields. The pretreatment experiments called for reaction of lignite, water, and sodium carbonate under batch conditions. The optimal conditions for breakdown of the lignite are listed. Decarboxylation experiments were carried out using benzoic acid and pretreated lignite. Two procedures for chemical decarboxylation were investigated: (1) the copper/quinoline method; and (2) the persulfate/silver ion method. The former method showed some conversion of benzoic acid to benzene, but quantitation was difficult with the complexity of the product mixture. The latter method showed an identifiable 41% yield of benzene. The decarboxylation work is detailed in Section 4. Preliminary engineering designs for pilot and full-scale facilities are presented. 17 references, 15 figures, 11 tables.

6258 **(DOE/ET/12138—1388) Reactivity of iron oxide sorbents for hydrogen sulfide removal from hot syngas.** Hasatani, M.; Wen, C.Y. (West Virginia Univ., Morgantown (USA). Dept. of Chemical Engineering). Sep 1977. Contract AC21-76ET12138. 56p. NTIS, PC A04/MF A01. File Number DE83009300.

Reactivity of an iron oxide pellet containing 45 wt % $Fe_2O_3$ with a hot gas containing $H_2S$, CO and $H_2$ was studied in a thermogravimetric analyzer (TGA) at temperatures between 600 to 900°C. During the first period of the reaction, both the sulfurization (reaction with $H_2S$) and the reduction (reaction with $H_2$ and CO) take place simultaneously. Spongy metal iron formed as the result of the rapid reduction reaction is much more reactive with $H_2S$ than the iron oxide itself. Therefore, reactivity studies were conducted for reduction (using iron oxide pellet) and for sulfurization (using completely reduced pellet) separately. The reduction experiment resulted in the following findings: (1) for sample pellets of size smaller than 0.2 mm, the chemical reaction rate controls the reduction rate. The activation energy obtained from the Arrehnius plot is 12.3 kcal/mol, (2) the effect of diffusion on the reduction rate becomes increasingly important as the pellet size increases beyond 0.2 mm. For the sample pellet of 6.4 mm in diameter, the rate is dominated by the diffusion rate. From the results of the sulfurization experiment, it has been observed that the reaction is approximately first order with respect to $H_2S$ and that the final sulfurized iron has the composition range between $FeS_{1.1}$ to $FeS_{1.2}$. The sulfurization reaction rate observed showed nearly the same trends as that in the reduction rate as indicated in (1) and (2) above. The activation energy obtained for the sulfurization is 2.65 kcal/mol. 3 references, 35 figures.

6257 **(DOE/ET/14804—T4) Two-stage liquefaction. Quarterly report, January-March 1982.** (C-E Lummus, Bloomfield, NJ (USA)). 2 Apr 1982. Contract AC22-79ET14804. 3p. NTIS, PC A02. File Number DE85003706.

The major accomplishments were reduction in SCT reaction severity and improved extract recovery in deashing. LC-Fining conditions have been modified to product a -650°F overall yield structure.

6258 **(DOE/LC/10713—1663) Support research on chemical, mechanical, and environmental factors in underground coal gasification. Final technical report.** Edgar, T.F.; Humenick, M.J.; Thompson, T.W. (Texas Univ., Austin (USA)). Mar 1984. Contract AS20-81LC10713. 213p. NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE85001960.

The general goal of this research has been to develop basic data and mathematical models in order to better understand information obtained from large scale field experimentation in underground gasification of Texas lignite. The chemical engineering research has focused on the topics of combustion tube studies of water influx, investigation of cavity growth mechanisms, cracking of pyrolysis products, and analysis of flow patterns in UCG. The petroleum engineering research has focused on subsidence analysis, creep testing and modeling, and effects of overburden drying. Good agreement between subsidence model predictions and data from the Hoe Creek No. 2 field experiment has been obtained. Environmental effects of UCG have been studied both for surface processing of wastewater as well as subsurface phenomena. Activated sludge processing of wastewater seems feasible and pertinent laboratory data have been acquired. Adsorption characteristics and microbial activity for different species in contaminated groundwater have been determined for the Tennessee Colony, Texas, field test site. 100 references, 95 figures, 10 tables.

6259 **(DOE/MC/19301—4) Coal Gasification Research Studies. Project 61063 quarterly report, May 20-August 19, 1983.** (Institute of Gas Technology, Chicago, IL (USA)). Nov 1984. Contract AC21-82MC19301. 21p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85003474.

The Coal Gasification Research Studies program consists of three tasks: (1) coal ash behavior studies; (2) high-pressure fluidization studies; and (3) high-temperature fluidization studies. During this quarter, seven gasification runs were made in the 2-inch fluid-

ized-bed gasifier at 1800°F using gas mixtures of both high (5%) and low (0.2%) oxygen content. The carbon conversion of these runs ranged from 35% to 98%. Although corrosion products from the reactor walls presented problems in analysis, the reactor residue showed that iron silicates were formed in the high-oxygen runs, but very few were produced when a low-oxygen content gas was used. In the high-pressure fluidization studies, tests at ambient conditions in a 12-inch-diameter column with a multi-orifice distributor showed that the pressure probe signal was not clean due to the large number of bubbles produced by this type of distributor. Using five- and seven-nozzle distributors gave a much cleaner signal from the pressure probes. It was also found that a substantial number of the bubbles do not rise vertically, but move at an angle through the column. A new pressure probe configuration was designed to account for these bubbles. The test results indicate, however, that a much higher scanning rate will be needed to correctly measure their velocities. In the high-temperature fluidization studies, the modification of the existing unit continued. The preheater furnace was cleaned and repiped, and a computer room to maintain the proper temperature and humidity for the data acquisition hardware was constructed. 8 figures, 1 table.

6260 **(DOE/PC/30027—56) Recycle slurry oil characterization. Third annual report, October 1, 1982-September 30, 1983.** Burke, F.P.; Winschel, R.A. (Conoco, Inc., Library, PA (USA). Coal Research Div.). Oct 1984. Contract AC22-80PC30027. 103p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE85002615.

This report includes results of our analyses of coal derived oils from Wilsonville ITSL Run 242 operated from November 1982 to January 1983. One hundred twenty-six samples were analyzed from Run 242 as well as four samples from Run 243. We performed a statistically designed set of experiments to compare the thermal reactivities of second-stage feeds from Run 242 and Lummus Run 3LCF9. Analyses of samples from Lummus Run BLCF52 were used to determine the effects of LC-Finer operating conditions on product solvent quality. Eight batches of various hydrogenated pyrenes were made for use as model coal liquefaction solvents. The characteristics of the process oils from Run 242 are significantly different from the characteristics of the corresponding process oils from Lummus PDU operations, although both operations were conducted in the ITSL mode. For many measured parameters, the data from Run 242 and the Lummus operations do not share a common range. Much of the difference may be ascribed to differences in the first-stage (thermal) severities and to selectivities of the deashing operation between the Lummus and Wilsonville operations. Characteristics of the start-up solvents may also have influenced this comparison. First-stage coal conversions to THF solubles averaged 91% for Run 242. This is 3 to 4% absolute greater than the THF conversions calculated for Lummus PDU runs operated at similar temperature and pressure conditions and is consistent with the generally lower first-stage space velocity used in Run 242. The more severe first stage conditions used in Run 242 may be one reason for the different first-stage yields and different second-stage feed compositions in that run as compared to PDU operations. Appendix II has been entered individually into EDB and ERA. 17 references, 30 tables, 7 figures.

6261 (DOE/PC/30027—56, pp 76-99) **Modeling of coal liquefaction processes: a literature review. Appendix II.** Schultz, R.H. Oct 1984. NTIS, PC A06/MF A01. File Number TI85002615.

In Recycle slurry oil characterization. Third annual report, October 1, 1982-September 30, 1983.

Experimenters have used a wide variety of compounds in coal liquefaction research, both as hydrogen donating solvents and as model compounds to elucidate coal and solvent reactions at liquefaction conditions. This survey examines thirty-eight papers dealing with model compound studies. The following general conclusions have been drawn: Hydrogenation reactions appear to proceed by free radical mechanisms. The reactions are generally first order. Hydroaromatic compounds such as tetralin are commonly used as model solvents and free radical sources such as dibenzyl as model hydrogen acceptors. No a priori method for predicting solvent ability has been developed, and even isomers of the same compound, such as tetralin and methylindan, can show marked differences in donor ability. Solvents can donate hydrogen by two different methods: By donating their hydrogen directly to the acceptor or by shuttling gaseous hydrogen to the acceptor. Hydroaromatic solvents tend to isomerize to methylindan types of structures and, at harsher conditions, thermally crack. These other structures are very poor hydrogen donors at liquefaction conditions. The problem of isomerization probably will occur in all hydroaromatic systems. It cannot be eliminated since the methylindan types of isomers equilibrate with the hydroaromatics. In addition, isomerization and cracking reactions appear to be accelerated by the presence of free radicals such as are produced during coal liquefaction. Isotopic studies have supported the conclusion that hydrogenation occurs by a free radical mechanism. In fact, isotope tracer studies have indicated that undesirable isomerization products may come from particular free radical percursors, while other free radicals will not lead to isomerization or cracking. 38 references.

6262 **(DOE/PC/40091—T10) Development of significantly improved catalysts for coal liquefaction and upgrading of coal extracts. Quarterly progress report No. 10, January 1-March 31, 1984.** Wolfson, S.L.; Kutzenco, P.D.; Preston, W.J.; Muchnick, T.L.; Hyman, D. (American Cyanamid Co., Stamford, CT. Chemical Research Div.). Dec 1984. Contract AC22-81PC40091. 65p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85003792.

During 1979-80, a new generation of very active long-lived catalysts for hydrotreating was discovered at the Stamford Research Laboratories of the American Cyanamid Company. The catalysts are based on a unique substrate prepared in bead form from a rehydratable alumina. Their spherical shape, crush strength, and abrasion resistance make them ideal candidates for use in ebullated bed reactors. The beads have internal pore structures that are controllable over a wider range than conventional alumina supports, leading to active catalysts that are resistant to poisoning. In September 1981, the Department of Energy granted a 3-year contract to the American Cyanamid Company for the development of significantly improved catalysts for coal liquefaction and for upgrading coal extracts, utilizing bead substrates. During the first year of the contract (FY 1982), a facility for catalyst activity testing was constructed. An associated laboratory for carrying out specialized analytical procedures was established. Cold-flow studies were conducted and methods for studying the details of catalyst surfaces were developed. In FY 1983, the batch screening unit was commissioned and a series of initial catalyst tests completed with Illinois No. 6 coal and Wilsonville deashed resid. The CSTR aging unit was brought on stream and various process conditions were studied.

6263 **(DOE/PC/40801—T6) Solvent effects in supercritical extraction of coal.** Vasilakos, N.P.; Dobbs, J.M.; Parisi, A.S. (Texas Univ., Austin (USA). Dept. of Chemical Engineering). 13 Jul 1983. Contract FG22-81PC40801. 37p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85003279.

The specific physical and chemical characteristics of supercritical solvents and solvent mixtures that can affect the yield and the properties of coal extracts were experimentally investigated. Strong non-ideal interactions, such as polar bonding and hydrogen transfer, as well as synergistic interactions in multicomponent solvent mixtures, were shown to produce large deviations from the simple, density-driven supercritical solubility. These interactions can be manipulated to optimize supercritical coal extraction by reducing the severity of the extraction conditions (pressure in particular). Physical and chemical changes occurring in the coal structure during supercritical solvent extraction were also examined. 10 references, 5 figures, 9 tables.

6264 **(DOE/PC/50799—T4) Enhanced coal liquefaction by hydropyrolysis in supercritical fluids. Quarterly report, April-June 1984.** Paulaitis, M.E.; Klein, M.T.; Stiles, A.B. (Delaware Univ., Newark (USA). Dept. of Chemical Engineering). 1984. Contract FG22-82PC50799. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85001850.

Investigation of dibenzyl ether (DBE) thermolysis in supercritical water has continued with a study of the influence of water density on DBE consumption and product yields at the reaction

temperature of 374°C. The degree to which DBE pyrolysis is affected by water density can be clearly demonstrated by considering these data for a specific reaction time of 20 minutes. As the reduced density is increased from 0.2 to 1.3, the fraction of DBE remaining after 20 minutes decreases from approximately 0.90 to less than 0.10. Further work has also been done on the pyrolysis of benzyl phenyl amine (BPA). Pyrolysis of BPA in subcritical water at 340°C gave a product spectrum similar to that obtained for pyrolysis in supercritical water at 386°C. However, the yield of aniline decreased slighly with reduced temperature and the yield of toluene decreased substantially with reduced temperature. The product spectrum of BPA pyrolysis in a mixture of water and tetralin at 386°C was comparable to that found in previous experiments. Major products were aniline and toluene with lesser amounts of benzyl alcohol. The yield of toluene was unaffected by the addition of tetralin, while the aniline yield and overall BPA conversion decreased from values obtained by pyrolysis in supercritical water. The effect of the addition of tetralin on benzyl alcohol yield could not be determined from the present experimental results. Investigation of the phase equilibria at elevated temperatures and pressures for model coal-derived compounds in supercritical methanol has continued.

6265 **(DOE/PC/50799—T5) Enhanced coal liquefaction by hydropyrolysis in supercritical fluids. Quarterly report, July-September 1984.** Paulaitis, M.E.; Klein, M.T.; Stiles, A.B. (Delaware Univ., Newark (USA). Dept. of Chemical Engineering). 1984. Contract FG22-82PC50799. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85001851.

This research program involves a fundamental investigation of a novel coal liquefaction process that combines pyrolysis, supercritical-fluid solvent extraction, and in situ hydrogen generation through catalytic dissociation of methanol. The experimental work consists of determining: (1) coal pyrolysis reaction pathways, kinetics and mechanisms, and the identity and structure of reaction intermediates, (2) solubilities of coal-derived species in supercritical water, methanol, and water + methanol mixtures, and (3) reaction pathways involved in the generation of hydrogen by catalytic dissociation of methanol to carbon monoxide and hydrogen, and through the shift of carbon monoxide. Both model coal compounds and actual coals are studied.

6266 **(DOE/PC/60054—T4) Coal liquefaction: investigation of reactor performance, role of catalysts, and PCT properties. Technical progress report.** Brainard, A.; Shah, Y.; Tierney, J.; Wender, I.; Albal, R.; Bhattacharjee, S.; Joseph, S.; Seshadri, K. (Pittsburgh Univ., PA (USA). Dept. of Chemical and Petroleum Engineering). Oct 1984. Contract FG22-83PC60054. 522p. NTIS, PC A22/MF A01; 1; GPO Dep. File Number DE85002738.

This report presents the findings of a research effort directed to three tasks summarized below: Task 1: To develop a computer simulator for a direct coal liquefaction reactor. Task 2: To conduct a comprehensive review of indirect liquefaction for the production of fuels and, to a lesser extent, of chemicals. Task 3: To conduct a literature review and analysis of the physical, chemical, and thermodynamic properties (PCT) of the products from direct coal liquefaction processes. Appendix I-D has been entered individually into EDB and ERA.

6267 (DOE/PC/60054—T4, pp I.D.1-I.D.63) **Computer simulation of preheater and reactor in direct coal liquefaction.** Oct 1984. NTIS, PC A22/MF A01. File Number TI85002738.

In Coal liquefaction: investigation of reactor performance, role of catalysts, and PCT properties. Technical progress report.

This report describes a comprehensive computer simulation program that predicts the performance of coal liquefaction preheater and reactor. The simulator is interactive and allows the user to input any linear kinetic network by specifying the reaction paths. The user must also specify the operating conditions and the physical dimensions of the units. The simulator will then provide detailed information on the performance of each unit, the characteristics of each flow stream, and an overall summary of the products leaving each unit. The simulator also provides graphical (pictorial) outputs of the results. The input/output results are stored in a database for any future processing. Included in this report are model development, descriptions of the mathematical procedures used to predict the performance of the units, source code of the program, instructions for its use, and a sample problem showing both the input data and the resulting output, both in tabular and graphical form.

6268 **(DOE/PC/60785—5) Organic oxygen characterization of coal and coal liquids. Quarterly progress report, August-October, 1984.** Ehmann, W.D.; Hamrin, C.E.; Koppenaal, D.W. (Kentucky Univ., Lexington (USA)). Nov 1984. Contract FG22-83PC60785. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003247.

Organically bound oxygen is one fo the most abundant elements in coal, yet the amount and quality of data concerning its abundance, mode of occurrence and processing behavior are relatively lean. The rectification of this problem will require the development of appropriate methods of oxygen determination which have been lacking in the past. The stature of coal science today demands a technique for organic oxygen determination other than the outdated and error-prone oxygen-by-difference calculation. This investigation addresses this need and intends to develop methods suitable not only for total organic oxygen determination, but also for determination of oxygen functionality. The methods and techniques developed will then be applied to practical needs in characterizing the oxygen geochemistry of coal and the evaluation of coal drying on liquefaction behaviour.

6269 **(DOE/PC/60808—3) Evaluation of intermolecular attractive forces in coal derived liquids. Quarterly report, May 1984-July 1984.** Jones, M.B. (North Dakota Univ., Grand Forks (USA)). Nov 1984. Contract FG22-83PC60808. 29p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85003597.

To gain potential information concerning the difference between diethyl ether and THF as solvents for aromatic model compounds and coal derived preasphaltenes, NMR spectra of cyclohexane solutions of each solvent, both in the absence and presence of naphthalene, were obtained. Both solvents evinced similar upfield shifts in chemical shift in the presence of naphthalene, as designed, was not able to explain why THF is such a better solvent for aromatics than diethyl ether. Nine fresh preasphaltene (PA) samples were isolated via solvent fractionation from products of coal liquefaction experiments carried out at the University of North Dakota Energy Research Center. Quantitative dissolvabilities of these PA samples in twelve solvents were determined. Correlation of PA dissolvability with Hildebrand solubility parameter, net hydrogen bonding index, or donor number (DN) minus acceptor number (AN) values of solvents reveals general trends; however, none of these solvent parameters are adequate predictors of individual solvent behavior. A better predictor is DN/AN, which in addition to being useful for PA dissolvability, may also be employed to forecast effectiveness of a solvent for extraction or swelling of coal. 13 figures, 4 tables.

6270 **(DOE/PC/70006—1) Enthalpy and phase behavior of coal derived liquid mixtures. Technical progress report, July-September 1984.** Yesavage, V.F.; Kidnay, A.J. (Colorado School of Mines, Golden (USA). Dept. of Chemical and Petroleum Refining Engineering). 30 Oct 1984. Contract FG22-84PC70006. 51p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85001241.

Work was initiated on a program to study the enthalpy and phase behavior of coal derived liquid model compound mixtures. Calorimetric measurements were made on pure quinoline. These measurements extended the range of previous measurements which had been made on quinoline, and improved the accuracy of previously measured results in the vapor phase when the quinoline sample used was believed to contain considerable quantities of water. 5 figures, 4 tables.

6271 **(EGG-M—25783) Behavior of pressurized tubes of candidate alloys in a simulated low-Btu environment.** Smolik, G.R.; Flinn, J.E. (EG and G Idaho, Inc., Idaho Falls (USA)). 17 Sep 1984. Contract AC07-76ID01570. 15p. (CONF-840978—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003403.

From International symposium on high temperature corrosion in energy systems; Detroit, MI, USA (17 Sep 1984).

Tube specimens prepared from four candidate alloys for coal gasifiers (Incoloy 800H, Type 310 stainless steel, Haynes 188, and IN-657) were exposed in an environment simulating low-Btu conditions at 815°C. The test environment selected to represent slagging low-Btu gasifiers (i.e., oxygen and sulfur potentials of $1 \times 10^{-19}$ and $1.3 \times 10^{-7}$ atm, respectively) was generated from a mixture of Ar, $H_2$, $H_2O$, and $H_2S$. Lifetimes of these alloys under pressurization were compared with those observed in air and in other less sulfidizing simulated gasifier environments. The development of oxide/sulfide scales upon the outer surfaces was evaluated. Sulfidation was more severe with exposure to the low-Btu condition compared to exposures in the other environments. The formation of external sulfides stimulated by strain induced cracks. Incoloy 800H experienced the greatest amount of sulfidation, which led to hot corrosion, i.e., the formation of molten eutectics. This contributed to a reduction in the endurance of this alloy. Although external sulfides developed on the other alloys, particularly at surface cracks, lifetimes were not noticeably affected for test durations of up to 400 h. 6 references, 6 figures, 3 tables.

6272 **(EPRI-AP—3749) Coproduction of methanol and electricity. Final report.** Deane, A.A.; Huber, D.A.; DeRosa, J.; Hsieh, B. (Burns and Roe/Humphreys-Glasgow Synthetic Fuels, Inc., Paramus, NJ (USA); General Electric Co., Schenectady, NY (USA)). Oct 1984. 203p. Research Reports Center, Box 50490, Palo Alto, CA 94303 $19.00. File Number TI85920124.

This study is an evaluation of the process design and economics of producing methanol fuel for utility application. The commercially available Imperial Chemical Industries (ICI) methanol synthesis process is utilized in a once-through configuration using the unconverted gas as a gas turbine fuel in a combined-cycle power plant. As a result, methanol is coproduced with electricity from medium-Btu gas in an oxygen-blown integrated gasification combined-cycle power plant (IGCC) fired by Illinois No. 6 coal. The revenue required for methanol production was determined by crediting the methanol/electricity coproduction case revenue requirements with revenue requirements from a non-methanol producing IGCC plant of the same net output of electricity as the power plant in the coproduction plant. In both cases, the Texaco coal gasification system was employed for gas production. Although not more efficient than a dedicated methanol plant, coproduction of methanol in a regulated utility owned once-through configuration shows a potential savings of 50% over the minimum required selling price of methanol from a dedicated plant owned by a non-regulated producer. 18 figures, 41 tables.

6273 **(ORNL/TM—8873) Assessment of the need for an advanced high-strength chromium-molybdenum steel for construction of third-generation gasifier pressure vessels.** Swindeman, R.W.; Thomas, R.D.; Nanstad, R.K.; Long, C.J. (Oak Ridge National Lab., TN (USA)). Oct 1984. Contract AC05-84OR21400. 56p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85002865.

The process conditions, construction methods, and materials selections for near-term gasifier pressure vessels were examined to determine whether or not an immediate need exists for an advanced high-strength chromium-molydenum steel. We found that the second-generation gasifier vessels will be relatively small [3 to 6m (10 to 20 ft) in diameter], will operate at low pressures [5.2 MPa (750 psi) or less], and will be cooled by waterwalls or water jackets to keep the temperature low [316°C (600°F) or less]. For most gasifiers, carbon steel appears to be an adequate material for construction; however, some gasification processes being examined could require operating pressures to 8.3 MPa (1200 psi). The eventual commercialization of these processes would require vessels with diameters of 9m (30 ft) or more. For these conditions, an advanced high-strength chromium-molybdenum steel would be economically attractive. The development schedule for such an alloy could be timed to have the alloy available in five years. 63 references, 16 figures, 6 tables.

6274 **(ORNL/TM—9134) Assessment of the performance of instrumentation, materials, and components in the bi-gas coal gasification pilot plant.** Judkins, R.R.; Greenstreet, W.L.; Hammond, J.P.; Horton, J.R.; Raptis, A.C. (Oak Ridge National Lab., TN (USA)). Oct 1984. Contract AC05-84OR21400. 80p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85003810.

The performance of instrumentation, materials, and components at the Bi-Gas Pilot Plant in Homer City, Pennsylvania, was assessed. Although problems at the Bi-Gas plant do not preclude successful operation and evaluation of the gasification process, several problems that are critical to successful commercial development were identified. The most critical process instrumentation problems relate to measurement of mass flow and temperature. Materials problems included degradation due to erosion, corrosion, stress corrosion cracking, warpage, and thermal fatigue. Component performance problems were due primarily to lack of component development for specific applications. Typically, poor performance was observed in solids handling and material transfer equipment.

6275 **(ORNL/TM—9194) Corrosion studies at the Wilsonville, Alabama, coal liquefaction facility during 1983.** Keiser, J.R.; Olsen, A.R.; Newsome, J.F.; Howell, M. (Oak Ridge National Lab., TN (USA)). Oct 1984. Contract AC05-84OR21400. 30p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85003805.

During 1983, Oak Ridge National Laboratory continued a study of materials performance at the Wilsonville, Alabama, Advanced Coal Liquefaction Research and Development Facility. Materials performance was evaluated by exposure and analysis of corrosion coupons and U-bend specimens, chemical analysis of related process streams, and ultrasonic determination of the thickness of walls of various components. The results of these studies are useful to current plant operators and to designers of future large-scale plants. 18 references, 4 figures, 12 tables.

6276 **(PB—82-262551) Fundamentals of fluidization of sticky particles.** Huang, C.S.; Arastoopour, H.; Weil, S.A. (Institute of Gas Technology, Chicago, IL (USA)). Aug 1982. 26p. (GRI—81-0068). NTIS $7.50.

Investigating the effects of temperature, air velocity, and particle residence time on high-density polyethylene particle bed material revealed an increase in agglomeration with increasing bed temperature and particle residence time. However, excessive temperature rises resulted in sintering and defluidization. Near the melting point of the bed material, the particle surface melted and liquid bridges formed between particles contacting eath other. Higher temperatures led to a lower viscosity liquid on the particle surfaces, and as a result, liquid bridges developed more quickly. These observations will provide a basis for a predictive agglomeration model to design and operate coal gasifiers.

6277 **(PNL—5273) Effects of inhalation exposure to SRC-II heavy and middle distillates.** Springer, D.L.; Miller, R.A.; Weimer, W.C.; Ragan, H.A.; Buschbom, R.L.; Mahlum, D.D. (Pacific Northwest Lab., Richland, WA (USA)). Nov 1984. Contract AC06-76RL01830. 68p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85004327.

To expand the data base on potential health effects of coal liquefaction materials, we have performed studies with both solvent refined coal (SRC)-II heavy distillate (HD) and middle distillate (MD). Weight gain for exposed animals was less than that of controls and was dose-related, ranging from no significant difference for animals in the low-exposure group to failure to gain in the high-dose animals. Liver weights increased significantly over controls, and thymus weights decreased for animals sacrificed at 5 and 13 weeks. After both exposure periods, there were significant treatment-related decreases in erythrocyte parameters and in certain types of white blood cells (WBC). Bone marrow cellularity, and numbers of megakaryocytes consistently decreased, suggesting that

bone marrow is a target tissue for high-boiling coal liquids. Microscopic evaluation of tissue indicated exposure-related changes is listed. In contrast to the reported mutagenic and carcinogenic effects observed for the high-boiling coal liquids, middle-boiling-range materials lacked such activity in these assays. These data demonstrate a great deal of similarity in the kinds of effects observed following exposure to middle- and high-boiling-range coal liquids. However, the significance of changes in organ weights and peripheral blood parameters are not always readily apparent following a subchronic study. Because of this, we exposed animals to HD in a manner similar to that for the subchronic experiment and have followed these animals throughout their lives for the development of adverse effects such as reduced longevity and the appearance of tumors. Results from this study will be available for mice in FY 1985 and for rats in FY 1986.

6278 **(SAND—77-1022C) Electrical and seismic-acoustic results from the second Hanna in-situ coal gasification experiment.** Beckham, L.W.; Bartel, L.C.; Garbin, H.D.; Seavey, R.W. (Sandia Labs., Livermore, CA (USA)). 1977. 16p. (CONF-770652—5). NTIS.

From 3. annual underground coal conversion symposium; Fallen Leaf Lake, CA, USA (6 Jun 1977).

Sandia Laboratories is developing electric and seismic-acoustic remote monitoring techniques to detect and map underground coal gasification. The electric methods being evaluated are a modified Schlumberger technique and a dynamic Misse-a-la-Masse technique and the seismic-acoustic methods being evaluated are an induced seismic transmission and reflection technique and a passive acoustic technique. Results of the electrical and seismic-acoustic instrumentation from the Hanna II experiment conducted by the Laramie Energy Research Center at Hanna, Wyoming, are reported. Comparison of thermal data to the electric and seismic-acoustic results shows that effects associated with the process can be detected and it is possible to delineate the underground coal gasification process. The feasibility of using these remote monitoring techniques to map and delineate the reaction zone is established.

6279 **(SAND—84-2131) Coal liquefaction research. Quarterly report, July-September 1984.** Granoff, B. (ed.). (Sandia National Labs., Albuquerque, NM (USA)). Nov 1984. Contract AC04-76DP00789. 53p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85003275.

This quarterly report for the period July through September 1984 summarizes activities in Sandia National Laboratories' continuing program of coal liquefaction research. The primary goals are to: explore novel catalytic concepts and materials for conversion of coal to liquid fuels; determine the effects of process variables on catalyst deactivation; determine the effects of coal structure and solvent properties on low temperature dissolution; study the kinetics and catalysis of hydrogen transfer reactions; develop an understanding of slurry gelling phenomena; and provide a technical assessment of coal liquefaction processes. During this period, work was performed on: the rheology of Illinois No. 6 coal in hydrogenated creosote oil; dissolution chemistry of subbituminous coal; pyrite catalysis; liquefaction of Illinois No. 6 coal in indole; characterization and activity testing of catalyst samples from Wilsonville Run 246; catalyst deactivation modeling; laboratory studies of deactivation using a micro-flow reactor; low temperature pyrene hydrogenation; and technology assessment of coal liquefaction processes.

6280 **(UCRL—53572) Underground coal gasification: status and proposed program.** Stephens, D.R.; Hill, R.W.; Borg, I.Y. (Lawrence Livermore National Lab., CA (USA)). 13 Aug 1984. Contract W-7405-ENG-48. 27p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85004168.

Technical uncertainties remaining in the UCG technology include specific criteria for site selection, large-scale burn interactions, details of process control, multiple well operation, overall system reliability, subsidence, and water quality effects. Considerable effort has been expended on understanding and controlling the process, on predicting and mitigating subsidence, and on maintaining water quality. Some data are available on site acceptability, but as yet information from large-scale field tests are not in the public domain. Commercialization of UCG will not be possible until such data become available. A program plan to commercialize UCG in an orderly, paced manner has been developed. The program would cost $200 million over seven years, some of which could be cost-shared with industry. The proposed program includes development of a more detailed program plan. The laboratory component of the program, although only a small fraction of the budget, is crucial. It contains environmental research, modeling, experimental studies, economic and system studies, instrumentation development, and materials studies. The field component includes UCG of both flat and steeply dipping coal beds as well as of less tractable bituminous coal. The field projects involve development of criteria for site selection and characterization, large block tests in bituminous coal, simple, small-scale field tests, subsequent more complex and longer-running tests, and finally large scale, or pilot tests. Steam-oxygen gasification would probably be used. 48 references, 11 figures, 6 tables.

6281 **(UCRL—91786) Summary results of the Centralia partial seam CRIP underground coal gasification field test.** Cena, R.J.; Hill, R.W.; Stephens, D.R.; Thorsness, C.B. (Lawrence Livermore National Lab., CA (USA)). Nov 1984. Contract W-7405-ENG-48. 10p. (CONF-841201—21). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003452.

From ASME winter annual meeting; New Orleans, LA, USA (9 Dec 1984).

A field test of the controlled retracting injection point (CRIP) concept of underground coal gasification is described. The test utilized the high wall geometry of the Centralia open pit mine to gasify fourteen hundred cubic meters of coal over a thirty day period, using primarily steam and oxygen as the injected reactants. Three distinct periods of gasification are discussed: the initial period, using a vertical production well, which produced a gas heating value of 219 kJ/mole; a second slant production well period, yielding 261 kJ/mole gas following a successful CRIP maneuver; and third, a post roof collapse period during which the gas heating value dropped to 194 kJ/mole. 7 references, 11 figures, 4 tables.

6282 **Metallography for coal liquefaction pilot plants.** Keiser, J.R.; Leslie, B.C. (Oak Ridge National Laboratory, Oak Ridge, TN). pp 28 of Shaping our energy future. Knoxville, TN, USA; LTM Consultants (1984). (CONF-840229—).

From 11. annual WATTec conference and exposition - shaping our energy future; Knoxville, TN, USA (21 Feb 1984).

Abstract only.

During the past few years, four direct coal liquefaction pilot plants have been operated in the United States to evaluate several liquefaction processes. Oak Ridge National Laboratory has assisted pilot plant operators by assessing materials performance through supply and examination of corrosion samples, on-site examination of equipment, and analysis of failed pilot plant components in our laboratory. This paper describes these examinations, which have revealed chloride and polythionic acid stress corrosion cracking, water-side pitting, sulfidation, and a chloride-related acid attack. The results of these analyses have helped identify corrosion problems and make proper material selections or design changes, and the results have provided designers of demonstration and commercial plants with information useful in selecting materials for the proposed plants.

6283 **Exposure tests of refractories in the 15 t/d Westinghouse PDU fluidized-bed gasifier.** *Materials and Components in Fossil Energy Applications;* No. 46, 5-6(1 Oct 1983).

A wide variety of coals, including two petroleum cokes, were gasified in the steam-oxygen mode. The feedstock sulfur content ranged from 0.5 to 2.3 wt%. The resulting product gas composition had effective equilibrium oxygen and sulfur partial pressures in the range of $10^{-13}$-$10^{-14}$ atm and $10^{-8}$-$10^{-9}$, respectively. The materials tested and the changes in their physical properties after exposure in the gasifier are listed.

6284 **Materials selection for the SRC-I demonstration plant.** *Materials and Components in Fossil Energy Applications;* No. 46, 1-5(1 Oct 1983).

Experience gained at the solvent-refined coal (SRC) pilot plants at Wilsonville, Alabama and Tacoma, Washington and also at other liquefaction pilot plants has been used to specify the materials of construction for the process portion of the next generation of SRC plant, expected to be in the 6000 tons/day range. Three major areas of concern for materials selection are: rapid wear of letdown valves, erosion of hot slurry lines, and corrosion of solvent fractionation columns. In other sections of the plant, available technology will be utilized to hydrocrack and coke the SRC product. As a result, the materials of construction for these areas will be chosen based upon refinery experience. Similarly, available technology will be used for the gasification, gas treatment, sour water stripper, and oxygen (cryogenic) plant.

6285 **Experimental study of the mechanism of constant pressure cake filtration: clogging of filter media.** Leu, W.; Tiller, F.M. (Univ. of Houston, TX). *Separation Science and Technology;* **18**: No. 12-13, 1351-1369(1983). Contract AS05-81ER10946.

Failure of data taken in pilot plant filtration of liquefied coal to fit conventional analysis led to research summarized in this paper. Historically, the effect of migrating fine particles in cake filtration has been ignored in theoretical treatment. In usual development, the total resistance to flow has been broken into cake resistance R/sub c/ and medium resistance R/sub m/. Experimentors have only measured the total resistance and have assumed that R/sub m/ remained constant. In this investigation, a filter with seven probes was employed to measure the individual resistances. Medium resistance is found to increase with time and mass of dry cake per unit area due to migration of fine particles into the interestices of a filter medium.

## 0105 By-products

*REFER ALSO TO CITATION(S) 0105006326, 7522*

## 0106 Properties

*REFER ALSO TO CITATION(S) 0106006268, 6269, 6270, 6317, 6341, 6343, 6352*

6286 **(DOE/ET/11423—T7) Identification and cleavage of breakable single bonds by selective oxidation, reduction, and hydrolysis. Quarterly report No. 1, October 1-December 31, 1978.** Buchanan, D.H.; Mayo, F.R. (SRI International, Menlo Park, CA (USA)). 25 Jan 1979. Contract AC22-78ET11423. 24p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003830.

Bituminous coal is assumed to consist mostly of an aggregate of condensed aromatic and aliphatic rings, connected and made insoluble (but swellable) by crosslinks containing only single bonds. These connecting links consist mainly, possibly entirely, of combinations of carbon-carbon single bonds and ether (possibly ester) groups. It is at these crosslinks that the most extensive cuts can be made in the coal structure (to make it soluble or liquid) under the mildest conditions and with the least loss in fuel values. The objective of this project is to determine the proportion of the various kinds of connecting links and how they can best be broken; in other words, to determine the structure of coal with emphasis on the crosslinks. At present, our attention is directed to five kinds of connecting links: single (Ar-$CH_2$-Ar) and multiple methylene groups (Ar-$(CH_2)_2$-Ar) and three kinds of ethers, Ar-O-Ar, Ar-O-R, and R-O-R (Ar represents an aromatic aggregate and R is attached to O through at least one aliphatic carbon.) The work described in this quarterly report deals mainly with the oxidation of pyridine-extracted coal by $O_2$ and the cleavage by sodium in liquid ammonia of aromatic ether linkages in a pyridine-soluble, toluene-insoluble fraction of coal extract. Products from the NaOCl oxidation of pyridine-extracted coal were also studied by nuclear magnetic resonance (NMR) and acid-base titrations. 7 references, 2 figures, 6 tables.

6287 **(DOE/ET/11423—T8) Identification and cleavage of breakable single bonds by selective oxidation, reduction, and hydrolysis. Quarterly report No. 3, April 1-June 30, 1979.** Buchanan, D.H.; Mayo, F.R. (SRI International, Menlo Park, CA (USA). Chemistry Lab.). 13 Jul 1979. Contract AC22-78ET11423. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003828.

Bituminous coal is assumed to consist mostly of an aggregate of condensed aromatic aliphatic rings, connected and made insoluble (but swellable) by crosslinks containing only single bonds. The objective of this project is to determine the proportions of the various kinds of connecting links and how they can best be broken--in other words, to determine the structure of coal, with emphasis on the crosslinks and breakable single bonds. This report describes: (1) preparation of asphaltol from Illinois No. 6 coal; (2) fractionation of asphaltol with bases, benzyamine, 5% KOH in ethanol, and combination of these; (3) cleavages of asphaltol by methyl iodide, HI in pyridine solution, and trimethyliodosilane; (4) efforts to solubilize the black acids from NaOCl oxidation of extracted coal; (5) oxidation of extracted coal and asphaltol.

6288 **(DOE/ET/11423—T9) Processing of Illinois No. 6 coal. Final report.** (SRI International, Menlo Park, CA (USA)). 22 Feb 1983. Contract AC22-78ET11423. 11p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85003834.

This final report consists of a summary of the principal accomplishments and conclusions on this contract, and an index to the 16 quarterly reports. The objective of this research was to determine the relative importance of breakable C-O and C-C connecting links between condensed ring systems in Illinois No. 6 coal. Although we have not realized our original goal of quantitative measures of the different proportions of C-C and C-O connecting links in coal, we have shown that our Illinois No. 6 coal contains enough of what we think are -C-O- (ester and ether) links to dissolve 34% of the initial coal that would not dissolve in pyridine and to permit the remainder to swell further in pyridine. We conclude that the proportion of single methylene connecting links is small or unimportant (from low reactivity). We have found that oxygen will supplement oxidation by NaOCl, and we expect that it will supplement oxidation by nitric acid. Essentially all of our reactions have been performed at or below 100°C and at atmospheric pressure. We hope that metal catalysts will improve the selectivity of our oxidations and that our partially degraded coals will be more reactive than ordinary coals in conventional liquefactions. Our work offers a new and promising point of departure for investigation of coal liquefaction under milder than conventional conditions; such work on a new project is now under way.

6289 **(DOE/ET/11423—T10) Identification and cleavage of breakable single bonds by selective oxidation, reduction, and hydrolysis. Quarterly report No. 5, October 1-December 31, 1979.** Pavelka, L.A.; Mayo, F.R. (SRI International, Menlo Park, CA (USA)). 14 Jan 1980. Contract AC22-78ET11423. 24p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85003829.

Bituminous coal is assumed to consist mostly of an aggregate of condensed aromatic and aliphatic rings, connected and made insoluble (but swellable) by crosslinks containing only single bonds. The objective of this project is to determine the proportions of the various kinds of connecting links and how they can best be broken - in other words, to determine the structure of coal, with emphasis on the crosslinks and breakable single bonds. This report presents brief summaries and experimental details of the following tasks; acetylation of asphaltols and black acids; cleavages of asphatol 28-A; cleavages of benzylamine extraction products; investigations of black acids; oxidation and oxidation products of coal extracts and black acids; and gel permeation chromatography. 6 references, 1 figure, 5 tables.

6290 **(DOE/ET/11423—T11) Identification and cleavage of breakable single bonds by selective oxidation, reduction, and hydrolysis. Annual report, October 1, 1980-September 30, 1981.** Hirschon, A.S.; Zevely, J.; Mayo, F.R. (SRI International, Menlo Park, CA (USA)). 12 Nov 1981. Contract AC22-78ET11423. 21p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85003841.

The objective of this project is to determine the structure of bituminous coal by determining the proportions of the various kinds of connecting bonds and how they can best be broken. Results obtained during the past quarter are presented for the following tasks: (1) extractions and fractionations of coal products which covers pyridine extraction, fractionation of TIPS fractions, EDA extraction of Illinois No. 6 coal and swelling ratios of coal samples; (2) experiments on breakable single bonds which cover reactions of ethylenediamine and model ethers, reaction of pyridine-extracted coal with $Me_3SiI$, Baeyer-Villiger oxidations, reaction to diphenylmethane with 15% $HNO_3$, cleavage of TIPS with $ZnI_2$, and cleavage of black acids; and (3) oxygen oxidation No. 18. Some of the highlights of these studies are: (1) some model ethers are not cleaved by EDA under extraction conditions; (2) oxidation of diaryl ketones with m-chloroperbenzoic acid and saponification of the resulting esters in promising for identifying ketones, (3) treatment of a black acid with pyridine hydroiodide reduced the acid's molecular weight and increased its solubility in pyridine, but treatment with $ZnI_2$ was ineffective; (4) in comparison with 0.1 M $K_2S_2O_8$, 0.01 M persulfate is relatively ineffective in accelerating oxidation of $BnNH_2$-extracted coal in water suspension. 2 figures, 3 tables.

6291 **(DOE/ET/11423—T12) Identification and cleavage of breakable single bonds by selective oxidation, reduction, and hydrolysis. Quarterly report No. 6, January 1-March 31, 1980.** Pavelka, L.A.; Mayo, F.R. (SRI International, Menlo Park, CA (USA)). 9 May 1980. Contract AC22-78ET11423. 21p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85003842.

Bituminous coal is assumed to consist mostly of an aggregate of condensed aromatic and aliphatic rings, connected and made insoluble (but swellable) by crosslinks containing only single bonds. The objective of this project is to determine the proportions of the various kinds of connecting links and how they can best be broken - in other words, to determine the structure of coal, with emphasis on the crosslinks and breakable single bond. This report summarizes progress during the past quarter of the following tasks: (1) cleavages and alkylations of pyridine TIPS 28-A which covers treatment with zinc chloride in THF, alkylation, fractionation with KOH/ETOH, and solubilization with KOH in toluene; (2) cleavages of pyridine-extracted coal 18-A which includes pyridine hydroiodide in pyridine, zinc chloride in THF; (3) cleavage of pyridine-extracted coal with phenol and p-toluene sulfonic acid; (4) oxidation of pyridine-extracted coal with nitric acid; and (5) cleavages of benzylamine extraction products. 5 references, 2 figures, 4 tables.

6292 **(DOE/ET/12162—T1) Isolation and characterization of organometallic constituents from coal and coal liquefaction products. Final report.** Yen, T.F. (University of Southern California, Los Angeles (USA). School of Engineering). Mar 1983. Contract FG22-78ET12162. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85000022.

Porphyrins in coal can yield useful geochemical parameters, although their role is not well understood. Raw coal was exhaustively extracted with a benzene-methanol azeotropic mixture. The extracts were fractionated by column chromatography, with n-hexane and toluene as eluents. The toluene fractions were demetallated with methanesulfonic acid to obtain metal-free porphyrin concentrates in dichloromethane. Fractions were developed on a simple thin layer chromatograph with various ratios of toluene and dichloromethane. Different tools such as visible spectrophotometry, high- and low-resolution mass spectrometry, HPLC, AAS and microprobe, etc. have been used to characterize these fractions. DPEP, Etio and Rhodo series of porphyrins as well as nickel and vanadyl porphyrins were found in these fractions. A discussion on porphyrin types in relation to coal age as well as genesis is to be given. 6 references, 8 figures, 4 tables.

6293 **(DOE/FC/10159—1) Slag viscosity determination. Final report, January 1-December 31, 1983.** Streeter, R.C. (Bituminous Coal Research, Inc., Monroeville, PA (USA). National Lab.). 31 Aug 1984. Contract AC18-80FC10159. 38p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85004459.

This report discusses the results of sixteen high-temperature viscosity tests on slags derived from low-rank coals. The results of these slag viscosity tests led to the following conclusions: (1) the expected effect of alkali metal oxides in lowering slag viscosity may not in fact occur, and is probably dependent on the relative concentration of the alkali metal. (2) There can be significant differences in the compositions and viscosities of the ashes from two different low-rank coal samples taken from the same seam. (3) The effect of oxidation potential on slag viscosity is primarily related to the temperature at which the transition from the fluid to the plastic state takes place. The transition occurs at higher temperatures as the oxidation potential increases. The magnitude of this effect appears to be at least qualitatively related to the iron content of the ash, although the data from these studies were not sufficient to establish a quantitative correlation. (4) Overnight equilibration of a slag at temperatures at which it was in the plastic state failed to produce the expected decreases in viscosity. Instead, viscosity increases were observed, which were tentatively assumed to be due to gradual assimilation of solid material formed at the slag surface. Material balance calculations indicated that weight losses on the order of 7 to 13% of the initial ash weight occurred during ash melting. The extent of weight loss was primarily a function of ash sulfur content. Mineralogical analysis of the slags revealed plagioclase (anorthite) as the predominant major phase and pyroxene-group minerals (e.g., augite and enstatite) as common minor constituents. 6 references, 10 figures, 7 tables.

6294 **(DOE/PC/60015—18) Separation and characterization of coal derived components.** Hurtubise, R.J.; Silver, H.F. (Wyoming Univ., Laramie (USA). Office of Univ. Research). 10 Oct 1984. Contract AC22-83PC60015. 19p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85000647.

Work is continuing on the detailed interpretation of the field-ionization mass spectra of eight hydroxyl aromatic oils and asphaltenes fractions from Wyodak and Kentucky SRC samples. It has become clear that the interpretation of the spectra will be complicated by the presence of nitrogen compounds in the fractions and the amount of oxygen in the fractions. After several chromatographic experiments, it was determind that tetrahydrofuran should be used as the solvent to inject preasphaltenes-1 onto a high-performance silica gel column to eliminate anomalous chromatographic peaks. Two SRC samples from Dr. Howard Silver were characterized by the Chromasorb T/basic alumina procedure and infrared spectroscopy. Experiments were completed on the collection of a large amount of high-performance liquid chromatographic data from model compounds. The data will be used for mobile phase optimization and prediction of retention. 3 figures, 2 tables.

6295 **(DOE/PC/60807—5) Supercritical fluid chromatography/supersonic jet spectroscopy. Progress report, August 1, 1984-October 31, 1984.** Lee, M.L.; Goates, S.R. (Brigham Young Univ., Provo, UT (USA)). Nov 1984. Contract FG22-83PC60807. 14p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85003310.

Supercritical fluid extraction/fractionation has been demonstrated to provide ring-number fractionation of PAH materials of approximately the same efficiency as obtained by semi-preparative liquid chromatography. Furthermore, extraction and fractionation occur in the same operation, and solvent removal is greatly simplified when using supercritical $CO_2$. Assembly of the large vacuum expansion chamber and the pump-beam steering and collection optics for supersonic jet spectroscopy has been completed. The entire apparatus has been tested, and operates well. A heated nozzle arrangement for the interface between the supercritical fluid chromatograph and vacuum chamber has also been constructed. 7 figures.

6296 **(EPRI-CS—989-Vol.9) Nuclear assay of coal. Volume 9. Prototype design of a continuous coal assay system. Final report.** Spencer, C.M.; Gozani, T.; Brown, D.R. (Science Applications, Inc., Sunnyvale, CA (USA)). Oct 1984. 81p. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303. File Number TI85920113.

This report describes how constraints imposed by the physical principles of the various assay techniques, by the potential user and by the industrial environment have been accounted for in the design and construction of the Continuous On-line Coal Analyzer of Coal—CONAC. The report describes the overall instrument requirements for accuracy and precision in the determination of the elemental constituents of the coal along with its moisture, ash and calorific value. How these and other design requirements are met for each of the CONAC subsystems are also described. These subsystems embody the various non-intrusive assay techniques incorporated in the CONAC, including prompt gamma neutron activation analysis (PGNAA), microwave moisture monitoring, gamma ray densitometry, and hydrogen monitoring by neutron moderation. Other subsystems of the CONAC described in this report include the radioactive source-shielding system, the coal conveyance system, the data acquisition system, and the software operator interface. The general mechanical and electrical specifications for the CONAC are also included. 7 references, 19 figures, 5 tables.

6297 **(EPRI-CS—989-Vol.10) Nuclear assay of coal. Volume 10. Operation of a continuous coal assay system - laboratory performance. Final report.** Brown, D.R.; Gozani, T.; Spencer, C.M.; Viswanath, P. (Science Applications, Inc., Sunnyvale, CA (USA)). Oct 1984. 220p. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303. File Number TI85920114.

This report describes the full-scale continuous on-line analyzer of coal - CONAC, and its successful laboratory testing. The report gives the specifications to which the CONAC system was built. These specifications include basic coal analysis time of 1000 seconds and automatic calibration every 10,000 seconds. Various electrical and mechanical requirements are reviewed and details of the controlling computer system and software structure are given. The basic physical principles of prompt gamma neutron activation analysis upon which the CONAC analysis is based are given. The calibration of the CONAC for the laboratory testing is described; in this calibration the coefficients which convert the elemental signals measured by the CONAC instrument system to weight percentage of elements, moisture and calorific values are determined. This calibration was carried out using three sets of coal standards, carefully prepared for this purpose and characterized by three commercial coal analysis laboratories in accordance with ASTM procedures. The set of 17 coals used for the acceptance test calibration included 7 coals used by the Tennessee Valley Authority's Paradise Wash Plant, where the CONAC is to be installed, and 10 other coals from different parts of the USA and the world. The CONAC underwent a stringent laboratory acceptance test which included several tests to check its accuracy and precision for measuring the elemental constituents of coal, its moisture, ash and calorific value. These successfully completed tests are described. Other tests confirmed the excellent mechanical and electrical performance of all parts of the CONAC and checked its radiation levels, the software and the operator's interface. 25 references, 70 figures, 36 tables.

6298 **(NR—83-10) Orientating research on some methods for the determination of spontaneous heating of coal.** Tadema Wielandt, R.; Houpt, P.M.; Draayer, A.; Koenig, J.W. (Nijverheidsorganisatie TNO, Apeldoorn (Netherlands). Hoofdgroep Maatschappelijke Technologie). Jan 1983. 16p. (In Dutch). Nijverheidsorganisatie TNO, Hoofdgroep Maatschappelijke Technologie, Apeldoorn, Netherlands.

While carrying out work on the project 'Caloric loss and spontaneous heating in coal-piles' there appeared to be interest into studying the heating behavior of various types of coal. The purpose of the, here summarized, orientation research project was to find a method by which the tendency of several sorts of coal towards spontaneous heating can be compared. As the reactivity in oxidation reactions could be seen as a measure for the tendency towards spontaneous heating, a reactor was developed, wherein coal samples could be quickly oxidized with the help of atomic oxygen. It was thought that the reaction could be followed by monitoring the chemiluminescence emitted during oxidation. By measuring the light reflection of the coal surface, it was found that the chemiluminescence process occurred once the surface of coal was almost completely ashed. The developed chemiluminescence technique was, therefore, found to be both too insensitive and too unspecific to use as an oxidation monitor. From experiments carried out using Fourier-transform-infrared-spectroscopy (FTIR) it was found that this technique appeared to be more suitable to specifically follow the fast oxidation process.

6299 **(PML—1984-C35) Self-heating of sub-bituminous coal. Investigations 1983.** Heemskerk, A.H. (Nijverheidsorganisatie TNO, Rijswijk (Netherlands). Prins Maurits Lab.). Feb 1984. 38p. (In Dutch). Nijverheidsorganisatie TNO, Prins Maurits Lab., Rijswijk, Netherlands.

The results of the investigation into the heat generation of coal which has been performed under contract with BEOP, are collected. The relationship between the heat generation and the partial pressure of oxygen has been investigated for low oxygen concentrations (0-20%). An unequivocal relationship could be established, which is in agreement with the observations at high oxygen concentrations (10-100%). The loss in calorific values and in the activity of the coal has been established with long-term storage experiments performed at 305 and 323 K. It appears that the addition of such chemicals as sulfuric acid and iron salts that are frequently encountered in coal piles stimulate the heat generation. Adiabatic investigation reveals an equilibrium between the moisture in the gas phase and in the solid phase, leading to an adiabatic saturation temperature. This temperature is dependent on the flow rate and appears to remain between 348 and 363 K under normal storage conditions. It is evident from all experiments that the entire process of self-heating is determined by the chemical oxidation process generating heat and the physical process of evaporation consuming heat.

6300 **(TNO-HMT—83-013867) Simultaneous investigation on coal analyses with ten laboratories participating.** Joziasse, J. (Nijverheidsorganisatie TNO, Apeldoorn (Netherlands). Hoofdgroep Maatschappelijke Technologie). Nov 1983. 71p. (In Dutch). Nijverheidsorganisatie TNO, Hoofdgroep Maatschappelijke Technologie, Apeldoorn, Netherlands.

Ten Dutch chemical laboratories made an investigation on the reliability of coal analysis. Three samples were investigated and analyzed on following properties: moisture, ash content, volatiles, heat of combustion, carbon-, hydrogen-, oxygen-, nitrogen-, and sulfur percentages, and the melting traject of slags. The different data are analyzed statistically, e.g. with the Friedman- and Bartlett test and multivariance analysis.

6301 **(TNO-HMT—84-016) Pyrolysis - gas chromatography - mass spectrometry of coal.** Gevers, E.C.T. (Nijverheidsorganisatie TNO, Utrecht (Netherlands). Hoofdgroep Maatschappelijke Technologie). Feb 1984. 24p. (In Dutch). Nijverheidsorganisatie TNO, Hoofdgroep Maatschappelijke Technologie, Utrecht, Netherlands.

The usefulness of pyrolysis, combined with gas chromatography-mass spectrometry (GC-MS), as a technique for the characterization of coal is described. Samples of known elementary composition purchased from the Pennsylvania State Coal Data Base, were pyrolyzed at a temperature of 750 deg C. The pyrolysis temperature should be high enough to produce a sufficient amount of volatile compounds, but not too high lest a too far breakdown to undesirably small and unspecific molecules should occur. The pyrolysis products were analyzed online by means of GC-MS. Among the pyrolysis products approximately forty different compounds have been identified: small molecules like H/SUB/2S, COS, SO/SUB/2 and CS/SUB/2; aromatic hydrocarbons; heterocyclic aromatics and further phenols, alkanes and alkenes. On the basis of literature data more than thirty pyrolysis products of each coal species have been quantified. The results have been subjected to chemometric procedures as principle component analysis and clustering. Comparison of the results leads to some conclusions regarding the chemical

composition of the different coals. Mass spectrometry for coal analysis looks promising. (In Dutch)

6302 **(TNO-HMT—84-0132) Investigation of the possible application of microanalysis methods for the determination of carbon/hydrogen, oxygen, sulphur and nitrogen in coal products.** Rotscheid, G.J. (Nijverheidsorganisatie TNO, Zeist (Netherlands). Hoofdgroep Maatschappelijke Technologie). Dec 1983. 34p. (In Dutch). Nijverheidsorganisatie TNO, Hoofdgroep Maatschappelijke Technologie, Zeist, Netherlands.

Determination of the main components (elements) in coal, according to the ASTM/ISO standards is very time consuming. Performing these analyses on a micro scale (1-5 mg of sample) is regarded to be profitable with regard to time saving. The purpose of this investigation was to examine the application of existing micro-analytical methods for the determination of carbon, hydrogen, oxygen, sulfur and nitrogen in organic compounds, for the determination of these elements in coal or coal products, with or without modification of the method. One of the results of this investigation, viz. the development of fast, reliable method for the determination of total sulfur in coal and coal products has been reported earlier. This study deals with investigations aiming at the determination of C/H, N and O in coal and coal products by microanalytical methods. At the present stage of research no conclusive results can be reached. Preliminary results are presented and the direction for future research is indicated.

6303 **Thermochemistry of acid-base interactions of three coal samples of different ranks at elevated temperatures.** Chawla, B.; Arnett, E.M. (Duke Univ., Durham, NC). *Journal of Organic Chemistry;* **49**: No. 17, 3054-3059(24 Aug 1984). Contract FG22-82PC50807.

Heats of reaction (ΔH/sub rxn/) of aqueous tetrabutylammonium hydroxide (TBAH) with three coal samples of different grades (Wyoming Rawhide subbituminous, Texas Big-Brown lignite, and Illinois No. 6 bituminous) have been measured at 80°C with a Setartam C-80 calorimeter and the results obtained are discussed in terms of coal acidity. The temperature dependence of ΔH/sub rxn/ of the aqueous TBAH + Rawhide coal system has also been determined from 40°C to 100°C. Heats of immersion (ΔH/sub imm/) of the three coal samples have been measured at 40°C and 60°C in 10% aqueous TBAH (1.47 M) in tetrahydrofuran (THF) and also in 10% water in THF. The exothermic interactions of these coals toward TBAH are always in the following decreasing order: ΔH (Wyoming Rawhide) > ΔH (Texas Big-Brown) > ΔH (Illinois No. 6). Heats of immersion (ΔH/sub imm/) of Wyoming Rawhide coal in 31 liquid bases are reported at 80°C. The ΔH/sub imm/ values of Wyoming Rawhide and Texas Big-Brown coals in 12 selected bases at 80°C are correlated fairly well, the reactions of Wyoming Rawhide coal with liquid bases being slightly more exothermic than those of Texas Big-Brown coal. On the other hand, a comparison of ΔH/sub imm/ values of Illinois No. 6 coal with those of Wyoming Rawhide and Texas Big-Brown coals suggests that access to acidic structural units of Illinois No. 6 coal is different from that of the other two. 21 references, 7 figures, 6 tables.

## 0108 Waste Management

*REFER ALSO TO CITATION(S) 0108006346, 6741, 7404*

6304 **(AE—83-15) Application of bound fly-ash as a base course and fill material.** Spee, P.R. (Volker Stevin Wegin en Asfalt, B.V., Rotterdam (Netherlands)). 1983. 17p. Volker Stevin Wegin en Asfalt, B.V., Rotterdam, Netherlands.

Although there is a widespread interest in the recycling of residues, numerous problems have still to be overcome before the various products can be re-used on a large scale. Fly ash is a product which is already available in large quantities and will be even more freely available in the near future, whereas only a very limited quantity can be used at the moment. A Dutch road-building company Volker Stevin Roads and Asphalt B.V. already contributes toward the solution of various environmental problems, such as the application of residues and the sanitation of contaminated soil. It is now examining the opportunities in the use of fly ash.

6305 **(CRO-RK—6151-MCO-1) Application of fly ash in aerated concrete.** Douven, E.; van Koeveringe, L.; Ramakers, J. (Dutch State Mines (DSM), Heerlen). May 1984. 53p. (In Dutch). Dutch State Mines, Heerlen, Netherlands.

In foamed mortars with a density of upwards from about 625 kg/m/SUP/3, orientating tests had shown fly ash as a substitute of sand to give higher compression strength. In further research, bulk density and compression strength of elements vertically cast with foamed mortars containing fly ash as the aggregate are found to be less dependent on pouring height. In addition, thermal conductivity appears about 20% lower. Production of horizontally or vertically cast beams, panels and elements up to 100 x 500 x 2800 mm should be possible without any specific problems with respect to workability or formwork stripping. For the foamed concrete mortars, even with relatively high bulk densities, compression strength remains on the low side. This seems to indicate that the constructive applications with in the scope of the present research effort are generally not feasible, at least not in e.g. loadbearing beams and floors.

6306 **(DOE/FE/60088—T3) Chemistry and physics of E-beam stack gas processing. Technical progress report, 31 March-30 April 1983.** Costello, L.J. (Avco-Everett Research Lab., Inc., Everett, MA (USA)). 15 May 1983. Contract AC22-82FE60088. 6p. NTIS, PC A02. File Number DE85003833.

The objectives of this research are to develop a fundamental understanding of the significant chemistry and physics involved in the electron-beam irradiation of stack gases to facilitate projections to different operating conditions and enable optimization and scale-up of the process, per se. The project consists of 3 tasks: diagnostic development; experiments; and theory and modeling. In the last monthly report (dated 15 April 1983), we reported that there was a significant discrepancy between our measured $SO_2$ removal data and that predicted by our kinetics model. This current report describes additional experimental and modelling investigations that were undertaken over the past month in order to attempt to reconcile these differences and gain greater insight into the $SO_2$ removal mechanism.

6307 **(DOE/METC—84-34) Second conference on management of municipal, hazardous, and coal wastes: proceedings.** Sengupta, S. (ed.). (Miami Univ., FL (USA)). Sep 1984. 518p. (CONF-831244—). NTIS, PC A22/MF A01; 1; GPO Dep. File Number DE85001957.

From 2. conference on management of municipal, hazardous, and coal wastes; Miami Beach, FL, USA (5 Dec 1983).

Papers presented at the meeting are included in this proceedings. General topics discussed include: recovery of strategic material, institutional aspects, coal waste disposal, contamination potential, disposal alternatives, thermal destruction techniques, new products from waste, characterization and monitoring, and recovery technology. Separate abstracts have been prepared for individual papers within the scope of the Energy Data Base. (DMC)

6308 **(DOE/PC/40806—7) Chemistry of mercury in coal hydrgenation and wastewater treatment. Final report.** Filby, R.H. (Washington State Univ., Pullman (USA). Nuclear Radiation Center). 30 Oct 1984. Contract FG22-81PC40806. 161p. NTIS, PC A08/MF A01; GPO Dep. File Number DE85001848.

Mercury exhibits a high degree of volatility in both coal gasification and liquefaction processes because of the formation of elemental mercury. Process waters formed in liquefaction processes contain mercury as the $HgS_2^{2-}$ ion, resulting in high levels of soluble mercury (10 to 200 ng/mL). The objective of this research project was to study the behavior of mercury in liquefaction (and gasification) wastewaters during chemical and biological treatment prior to discharge to the environment. Because most water treatment processes involve biological degradation, e.g., the activated sludge process, and because mercury may be biomethylated under such conditions, this project was restricted to studying the behavior of aqueous $Hg^{2+}$ in the activated sludge process using a synthetic coal liquefaction/gasification wastewater. Mass balance data for a closed system laboratory treatment unit reveal that, over a 31 day period, 31.0 +- 0% of the Hg entering the treatment unit was vola-

tilized, 31 +- 1% of the Hg was lost with the waste mass, 26 +- 4% of the Hg remained in the mixed liquor and 7.0 +- 0% of the Hg was lost in the effluent. Mass balance closure for Hg was 95 +- 4%. It is concluded that gaseous Hg(0) is the volatile Hg species. The volatility of Hg is dependent on the presence of living mixed liquor organisms, implicating the biologically mediated reduction of $Hg^{2+}$ to $Hg^{0}$. Organomercury compounds ($CH_3Hg^{+}$) were not identified, but may be present at low concentrations. Data for adsorption/complexation of $Hg^{2+}$ with extracellular polymer (ECP) and cell wall (CW) fractions of the laboratory system mixed liquor were fitted to Freundlich adsorption isotherms. Results are discussed.

6309 **(DOE/PC/60265—T5) Development of process for combined NO/sub x//SO/sub x/ control. Technical progress report, October 1984.** (Science Applications, Inc., San Diego, CA (USA)). 26 Nov 1984. Contract AC22-83PC60265. 5p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85003486.

Testing of the copper-exchanged adsorbent was continued. Operating variables for both the adsorption and regeneration cycles were studied. The specific operating conditions were examined and a summary of their effects are described. The temperature of the feed gas and adsorbent beds was lowered to 350°C. The $SO_2$ loading capacity of the adsorbent dropped slightly; about 5% compared with adsorption at 400°C. The NO/sub x/ destruction reaction efficiency was also reduced at the lower temperature to less than 80% from an average destruction efficiency in the 80 to 90% range with an operating temperature of 400°C. The face velocity of the adsorbing gas was varied from about 100 to 300 ft/min (actual) in the adsorption beds. In general, the $SO_2$ adsorption capacity increases with decreasing face velocity, but quantitative data were not obtained. In addition to these tests, a longer-term test was conducted in which 17 adsorption-regeneration cycles were performed with each adsorption bed using the same adsorption-desorption conditions. At the beginning of this test, the adsorption times for Column A were about 90 minutes and about 100 minutes for Column B. At the completion of the test, about 48 hours later, the adsorption times were 68 minutes for Column A and 70 minutes for Column B. Thus, the adsorption capacities for both beds slowly decreased, 1 or 2% per cycle.

6310 **(DOE/PC/60409—T3-Vol.2) Feasibility evaluation of wet oxidation for combustion of coal slurries. Volume II. Appendices A-J. First quarterly report, 31 August-30 November 1983.** Engleman, V.S.; Kirstein, B.E.; deLesdernier, D.L. (Science Applications, Inc., La Jolla, CA (USA)). 1983. Contract AC22-83PC60409. 252p. NTIS, PC A12/MF A01; 1; GPO Dep. File Number DE85003869.

These appendices consist of bibliographic citations obtained by searching the Energy Database, Chem Abstracts, and Engineering Index for information on the following aspects of wet-oxidation processes: energy recovery; operating concepts and experience; modeling; kinetics and mechanism; oil recovery; sulfur removal; gas purification; dewatering; regeneration of sorbents; catalysis and additives. (DMC)

6311 **(DOE/PC/60409—T3-Vol.3) Feasibility evaluation of wet oxidation for combustion of coal slurries. Volume III. Appendix K. First quarterly report, 31 August-30 November 1983.** Engleman, V.S.; Kirstein, B.E.; deLesdernier, D.L. (Science Applications, Inc., La Jolla, CA (USA)). 1983. Contract AC22-83PC60409. 203p. NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE85003870.

Appendix K consists of bibliographic citations obtained by searching the Energy Database, Chem Abstracts, and Engineering Index for information on waste disposal aspects relating to wet-oxidation processes. (DMC)

6312 **(EPRI-CS—3369-Vol.3) Utility FGD survey: April-September 1983. Volume 3: April-June 1983.** Melia, M.T.; McKibben, R.S.; Pelsor, B.W. (PEDCo-Environmental, Inc., Cincinnati, OH (USA)). Oct 1984. 281p. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $23.50. File Number TI85920138.

This report, which is generated by a computerized data base system, represents a survey of operational and planned domestic utility flue gas desulfurization (FGD) systems. It summarizes infomation contributed by the utility industry, system and equipment suppliers, system designers, research organizations, and regulatory agencies. The data cover system design, fuel characteristics, operating history, and actual system performance. Also included is a unit-by-unit discussion of problems and solutions associated with the boilers, scrubbers, and FGD systems. The development status (operational, under construction, or in the planning stages), system supplier, process, waste disposal practice, and regulatory class are tabulated alphabetically by utility company. Simplified process flow diagrams of FGD systems, definitions, and a glossary of terms are attached to the report. Current data for domestic FGD systems show 114 systems in operation, 27 systems under construction, and 73 systems planned. The current FGD-controlled capacity in the United States is 42,135 MW.

6313 **(EPRI-CS—3369-Vol.4) Utility FGD survey: April-September 1983. Volume 4: July-September 1983.** Melia, M.T.; McKibben, R.S.; Pelsor, B.W. (PEDCo-Environmental, Inc., Cincinnati, OH (USA)). Oct 1984. 356p. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $28.00. File Number TI85920110.

This report, which is generated by a computerized data base system, represents a survey of operational and planned domestic utility flue gas desulfurization (FGD) systems. It summarizes information contributed by the utility industry, system and equipment suppliers, system designers, research organizations, and regulatory agencies. The data cover system design, fuel characteristics, operating history, and actual system performance. Also included is a unit-by-unit discussion of problems and solutions associated with the boilers, scrubbers, and FGD systems. The development status (operational, under construction, or in the planning stages), system supplier, process, waste disposal practice, and regulatory class are tabulated alphabetically by utility company. Simplified process flow diagrams of FGD systems, definitions, and a glossary of terms are attached to the report. Current data for domestic FGD systems show 116 systems in operation, 26 systems under construction, and 72 systems planned. The current FGD-controlled capacity in the United States is 43,186 MW.

6314 **(EPRI-CS—3708) Biofilm control studies using ferrate and sulfur dioxide. Final report.** Waite, T.D. (Miami Univ., FL (USA). Dept. of Civil Engineering). Oct 1984. 87p. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $11.50. File Number TI85920112.

This study evaluates the possibility of utilizing two new compounds for biofilm control. The two compounds studied were iron (VI) ferrate and sulfur dioxide. Previous studies have indicated that iron (VI) ferrate is an effective disinfectant of bacterial suspensions. Therefore, the possibility of ferrate inactivating bacterial film was studied in test laboratory condensers. Bench scale flow through systems were established and environmental conditions were set so that a bacterial film of greater than 100 microns developed in less than two weeks operation. The effectiveness of ferrate treatment for biofouling control was ascertained by measuring film thickness vs. time in the test systems as a function of various ferrate doses. For ferrate concentrations similar to those effective in suspended systems, that is, $10^{-5}$M ferrate, good biofilm growth prevention was observed. When ferrate concentrations were decreased to below $10^{-6}$M, no repression of film growth was observed. Therefore, ferrate is a possible control chemical for biofilm growth prevention in condenser systems. The second part of this study dealt with the evaluation of sulfur dioxide as a biocidal agent. This study was only preliminary in nature and the main objective was to determine whether sulfur dioxide could act as a biocide against suspended bacterial systems. No biofilm studies were undertaken using $SO_2$ as a treatment chemical. The results indicated that sulfur dioxide is an effective biocide but its effectiveness is highly pH dependent. Several different types of bacterial were used as test organisms and all were rapidly inactivated at reasonable sulfur dioxide concentrations when the pH was below four. For neutral or basic pH very large $SO_2$ concentrations, often approaching two grams per liter, were required for reasonable disinfection kinetics. 65 references, 35 figures, 6 tables.

6315 **(EPRI-CS—3711-Vol.1) Sodium conditioning for improved hot-side precipitator performance. Volume 1. Field and laboratory studies. Final report.** Bickelhaupt, R.E.; Dahlin, R.S.; Gooch, J.P.; Landham, E.C. Jr.; Marchant, G.H. Jr. (Southern Research Inst., Birmingham, AL (USA)). Oct 1984. 93p. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303. File Number TI85920111.

This report is the first volume in a two-volume set dealing with sodium conditioning for hot-side electrostatic precipitators. This volume presents the results of field and laboratory studies of the degradation of hot-side precipitator performance and the restoration of performance by addition of a sodium-containing compound to the coal supply of a pulverized-coal-fired boiler. Volume 2 of the set, which was prepared by Stearns Catalytic Corporation, presents an engineering and economic analysis of the sodium-conditioned hot-side precipitator. The gradual deterioration in the performance of the hot-side electrostatic precipitator was attributed to tl.e depletion of sodium ions in the fly ash layer contiguous to the collecting electrodes. This depletion led to an increase in the electrical resistivity of the ash to an unacceptable level because sodium ions are the principal carriers of electrical charge in the ash at elevated temperatures. Compensation for this effect was achieved by the addition of sodium sulfate to the coal supply, raising the sodium content of the ash (expressed as a percentage of $Na_2O$) from 0.3 to 1.0 or 1.8%. This increase in sodium concentration reversed the degradation in precipitator performance. No undesirable side effects, such as increased slagging or fouling by the ash, were observed. Laboratory studies reproduced the increase of resistivity with time and confirmed the sodium depletion theory. 9 references, 18 figures, 11 tables.

6316 **(EPRI-CS—3711-Vol.2) Sodium conditioning for improved hot-side precipitator performance. Volume 2. Engineering and economic analysis. Final report.** Pearson, R.S.; Scheck, R.W. (Stearns Catalytic Corp., Denver, CO (USA)). Oct 1984. 51p. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303. File Number TI85920122.

This report is Volume 2 of a two-volume set. Volume 1, prepared by Southern Research Institute, presents the results of field and laboratory investigations of sodium conditioning at the Lansing Smith Station. This volume is concerned with an engineering and economic analysis of the process as employed at the station. The objectives of the Lansing Smith Station engineering analysis were to develop a concise description of the particulate removal system, its capital requirements, operating costs, and maintenance problems; and to determine the economic feasibility of chemical conditioning as a method to enhance particulate removal. The method for accomplishing this analysis included plant visits, reviewing plant data and records, the use of prior similar EPRI projects, and economic calculations using previously proven economic correlations including the current EPRI Economic Premises. The conclusions reached from the available data are that sodium sulfate does increase particulate removal in a low-sodium coal and chemical conditioning of coal can be done safely and economically when compared to other methods of particulate removal. 3 references, 7 figures, 15 tables.

6317 **(EPRI-CS—3715) Composition and leaching of FBC wastes at the Alliance Test Facility. Final report.** Eklund, A.G.; Wellington, T.M. (Radian Corp., Austin, TX (USA)). Nov 1984. 108p. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $13.00. File Number TI85920132.

In the past decade, a number of investigations of solid residues from fluidized-bed combustion (FBC) have been conducted. In 1979 and 1983, samples of FBC solid wastes were collected from the 6-x-6-ft test facility at the Babcock and Wilcox (B & W) Research Center in Alliance, Ohio, which is jointly sponsored by B & W and EPRI. Determinations and comparisons were made to evaluate differences in the solid compositions, physical properties, and leaching characteristics of samples from the 1979 process and a recent 1983 test burn. In general, the 1979 and 1983 solid wastes differed in physical and chemical properties; however, the two waste leachate compositions were fairly similar. Differences in the two wastes are largely attributed to changes made in combustion operating conditions. Similarities in the leachates are probably due to conformance in dissolution of species from similar crystalline structures in the two wastes and to solubility limits for certain aqueous species. 13 references, 5 figures, 10 tables.

6318 **(EPRI-CS—3724-SR) Fabric filter technology for utility coal-fired power plants.** Carr, R.C.; Smith, H.B. (Electric Power Research Inst., Palo Alto, CA (USA)). Oct 1984. 70p. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303, $10.00. File Number TI85920136.

This series of six articles was prepared at EPRI and is reprinted from the January-June 1984 issues of the Journal of the Air Pollution Control Association. The articles discuss the experiences of electric utilities in applying fabric filter (baghouse) technology for the collection of particulate matter at coal-fired electric power generating plants. The series presents new data obtained in research sponsored by EPRI on reverse-gas and shake/deflate cleaned baghouses and specifically addresses a number of unresolved issues in the design and operation of these units. The series' objective is to provide electric utilities, fabric filter manufacturers and vendors, research and development organizations, and regulatory agencies with current data on unit design and operating parameters and to foster the continued transfer of technical information in the field. The six articles are: Part I, Utility Baghouse Design and Operation; Part II, Application of Baghouse Technology in the Electric Utility Industry; Part III, Performance of Full-Scale Utility Baghouses; Part IV, Pilot-Scale and Laboratory Studies of Fabric Filter Technology for Utility Applications; Part V, Development and Evaluation of Bag-Cleaning Methods in Utility Baghouses, and Part VI, Future Research, Development, and Demonstration of Utility Baghouses. Separate abstracts appear in the Energy Data Base for each of these journal articles.

6319 **(EPRI-CS—3726) Coal-Waste Artificial Reef Program, Phase 4B.** (New York State Energy Research and Development Authority, Albany (USA)). Nov 1984. 267p. NTIS, PC A12/MF A01 - EPRI $22.00; GPO Dep. File Number DE85003061.

The Coal Waste Artificial Reef Program (C-WARP) has continued to investigate the environmental effects of disposing of fly ash and scrubber sludge in the ocean in the form of stabilized blocks. An artificial reef was constructed in the Atlantic Ocean with 500 tons of coal waste blocks on 12 September 1980. This report describes in detail the studies made from September 1981 through August 1983, the second and third year following placement of the coal waste reef. The effort includes laboratory and field studies to (1) measure physical block properties; (2) examine mineral phases; (3) determine the blocks chemical changes in seawater; (4) analyze leachate characteristics; and (5) collect environmental monitoring data on the reef. 74 references, 73 figures, 53 tables.

6320 **(EPRI-CS—3740) Materials testing in synthetic FGD environments. Final report.** Koch, G.H.; Beavers, J.A.; Christman, T.K. (Battelle Columbus Labs., OH (USA)). Nov 1984. 189p. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $17.50. File Number TI85920139.

A laboratory study was performed to evaluate the corrosion behavior of several alloys in simulated flue gas desulfurization (FGD) or $SO_2$ scrubber systems. The alloys were selected according to generic groups, e.g., nickel-base alloys, austenitic stainless steels, ferritic and duplex stainless steels, titanium and zirconium alloys and cobalt-base alloys. The synthetic scrubber environments contained chlorides, fluorides, calcium, magnesium, sodium and sulfates. The study showed that alloys suffered the most severe corrosion at intermediate chloride concentrations, 30,000 $g/m^3$, low pH and high temperatures, whereas at high ionic concentrations corrosion rates reduced. It was further shown that the amount of acid needed to achieve a pH of 1 was much higher at the low and intermediate chloride concentrations than at the high concentrations. It was argued that the higher hydrogen ion concentration would increase the corrosion rate of the alloys studied and that addition of fluoride to the test solution would further increase the corrosion rates. Although the nickel-base alloys were generally found to be the most resistant to different forms of corrosion attack such as general corrosion, pitting, intergranular corrosion and stress-corrosion cracking, other alloys such as the ferritic and duplex stainless steels and titanium alloys also showed excellent corrosion resistance

in certain environments. However, titanium suffered severe attack in solutions that contained relatively high fluoride concentrations. 43 references, 84 figures, 39 tables.

6321 **(EPRI-CS—3741) Aqueous discharges from steam-electric power plants: data evaluation.** White, H.R.; Powers, M.D.; Shih, C.C.; Maddalone, R.F. (TRW, Inc., Redondo Beach, CA (USA)). Nov 1984. 204p. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $19.00. File Number TI85920109.

The EPRI Aqueous Discharges from Steam-Electric Power Plants project is organized into two main tasks: data base review and evaluation of sampling and analysis methodology. This report presents the data evaluation results. Under the current project, data were collected on pollutants present in the aqueous discharge streams from steam-electric power plants. The data base included all 126 priority pollutants, as well as conventional and non-conventional pollutants. This entire body of data on utility pollutants was stored in a computerized data base management system. A methodology for identifying pollutants of concern to the utility industry was developed. The application of these criteria resulted in a ranked list of pollutants of potential concern to the utility industry. Pollutants on this list include: arsenic, cadmium, beryllium, chromium, total residual chlorine, phosphorus, sulfate, ammonia, manganese, copper, lead, nickel, iron, zinc, and selenium. The computerized data base was also utilized to calculate average mass discharge rates of pollutants from steam-electric power plants. These calculations indicate that sulfate, total suspended solids, and oil and grease are discharged in the largest quantities. Iron, manganese, ammonia, phosphorus, zinc and total residual chlorine are the pollutants discharged in the next largest quantities. 33 references, 9 figures, 28 tables.

6322 **(EPRI-EA—3770) Coal-cleaning and coal slurry wastewater: a literature review. Final report.** Minear, R.A.; Sayler, G.S. (Tennessee Univ., Knoxville (USA)). Nov 1984. 139p. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $14.50. File Number TI85920148.

Chemical water quality characteristics of coal cleaning and coal slurry transport wastewaters were documented following a review of published and technical literature. Computer assisted and manual literature searches were conducted to compile a literature data base describing the individual process technologies, wastestreams, inorganic and organic wastewater constituents, factors effecting chemical constituents of wastewaters. After a critical evaluation, 132 reference sources were used to define the current state-of-knowledge on wastewater characteristics associated with the two technologies. Broad range in the concentrations of specific inorganic and organic chemical constituents of the wastewaters are observed as a result of variability in the chemical composition of coals and different types of coal employed in various investigations. The concentrations of inorganic ions and trace metals ranged from a low of .0001 mg $l^{-1}$ - .01 mg $l^{-1}$ for cadmium to a high of 0.003 mg $l^{-1}$ - 9100 mg $l^{-1}$ for iron and 2600 mg $l^{-1}$ total sulfate in coal cleaning wastewater. In coal slurry wastewater, arsenic represents the lowest concentration range of 0.0002 mg $l^{-1}$ - 0.28 mg $l^{-1}$ with calcium demonstrating the highest range, 22.1 mg $l^{-1}$ to 1660 mg $l^{-1}$, with sulfate approaching 2500 mg $l^{-1}$. Relatively little information is available on the qualitative or quantitative nature of organic and inorganic constituents in either process wastewater. The variability in concentration values is further compounded by a lack of standardization in sampling and analysis procedures. 56 references, 14 figures, 41 tables.

6323 **(INTRON—83210) Concrete from fly ash.** (INTRON B.V., Maastricht (Netherlands)). Nov 1983. 124p. (In Dutch). INTRON B.V., Maastricht, Netherlands.

The research was carried out under contract with the Bureau Energy Research Projects (BEOP) in the framework of the National Research Program Coal. Aim was to investigate the possibilities of the use of fly ash and waste heat from the combustion of coal powder, specially for the production of aerated concrete. The investigation included: a literature survey on the subject; a feasibility study with Dutch fly ash for the production of aerated concrete; a cost benefit analysis; a feasibility study for the use of waste heat for the processing of fly ash.

6324 **(INTRON—84083) Slag/fly ash cement.** (INTRON B.V., Maastricht (Netherlands)). Apr 1984. 52p. (In Dutch). INTRON B.V., Maastricht, Netherlands.

An investigation has been carried out into slag fly ash cement made from ground blast furnace slag, powder coal fly ash and an alkaline activator. Cements consisting of 60% ground blast furnace slag and 40% fly ash have been prepared with various slag fineness and activators. A cement consisting of slag ground and 7% NaOH by weight of the slag plus fly ash as activator showed the best results and met the requirements for ordinary portland cement. A disadvantage of the activation by NaOH is that this slag activator has to be added as a solution in water. In wet grinding the slag showed considerable 'prehydration' and less well cementitious behavior than in dry grinding. In an accelerated carbonation test the slag fly ash cement performed badly in comparison with the major Dutch cements, portland blast furnace cement and portland cement. The cement appeared to be more silica-reactive than both reference cements. The frost-thaw resistance was similar. In comparison with the reference cements the slag fly ash cement showed severe efflorescence of sodium carbonate. The optimal cement will cost about Dfl 78.00 per ton, which is similar to the cost price of portland blast furnace cement. Slag fly ash cement can take a market share of 250000 ton cement per annum, which is about 5% of the market. Applications will mainly be in unreinforced precast concrete products such as pavement stones and blocks. (In Dutch)

6325 **(TVA/OP/EDT—84/35) Dowa process testing, second test series: Shawnee Test Facility. Final report, December 1981-April 1982.** Garrison, F.C.; Runyan, R.A.; Cummings, J.M.; Scrudder, R.O.; Pfeffer, S.J.; Dimoplon, W.; Olsen, S.D.; Smith, D.B. (Tennessee Valley Authority, Chattanooga (USA). Div. of Energy Demonstrations and Technology; UOP, Inc., Norwalk, CT (USA). Air Correction Div.). Aug 1984. Contract AI01-81FE15034. 354p. NTIS, PC A16/MF A01; 1; GPO Dep. File Number DE85003342.

The Dowa process is a dual alkali flue gas desulfurization (FGD) process which was developed in Japan. It combines the benefits of solution scrubbing, the use of limestone, and the production of stable gypsum as the waste product. The test series discussed is a followup to an earlier test program performed during 1979-1980 which had insufficient time for long-term reliability tests and did not include an aluminum regeneration subsystem. The test program evaluated the Dowa process for $SO_2$ removal from flue gas generated by a coal-fired boiler. This report discusses the results of the test program performed at TVA's Shawnee Test Facility from mid-December of 1981 through April 1982 and is referred to as the second test series. Startup problems, both mechanical and process, affected initial operation of the system and delayed testing. The nature of these problems is discussed. An empirical model was developed from the available data covering the operating parameters used for the testing. The model predicts $SO_2$ removal performance based upon recirculating liquor temperature, liquor-to-gas ratio, basicity, and absorber superficial gas velocity. The system obtained 80 to 95% $SO_2$ removal efficiency depending upon operating conditions and type and amount of absorber packing used. One of the three packing arrangements, a combination of 19 mm and 12 mm packings, was capable of 92 to 94% $SO_2$ removal efficiency at superficial flue gas velocities of 8.7 ft/second or less. No long-term demonstration run was possible because of time and financial limitations of the project. 4 references, 8 figures, 11 tables.

6326 **Recent results in the separation of metal chlorides by solvent extraction.** Sheng, Z.; Murtha, M.J.; Burnet, G. (Iowa State Univ., Ames). *Separation Science and Technology;* **18**: No. 14-15, 1647-1665(1983). Contract W-7405-ENG-82.

Solvent extraction is used to selectively separate an aqueous mixture of metal chlorides (Fe, Al and Ti) that is the product from the high-temperature chlorination of fly ash by the HiChlor process. Tertiary amines dissolved in xylene or kerosene are used to separate the Fe from the Al and Ti. Prior to extraction, the organic solution is contacted with HCl to convert the amine to the chloride salt. Data on the effects of organic-to-aqueous ratio, Fe, Al and Ti loadings, and HCl concentration in the aqueous phase are reported.

Iron is stripped from the loaded organic phase using dilute HCl. The raffinate is subjected to sparge crystallization with HCl to recover $AlCl_3.6H_2O$. The recovery of Ti from the aqueous phase after Fe removal requires the use of tributyl phosphate (TBP) in kerosene for the organic phase, and of higher acid concentrations. Decanol is used as a modifier to prevent formation of a third phase. 22 references, 9 figures, 2 tables.

## 0109 Environmental Aspects

*REFER ALSO TO CITATION(S) 0109006258, 6354, 7405, 7507, 7513, 7522*

6327 **(ORNL/FETEP—9) Environmental, health, and safety assessments for direct coal liquefaction: Volume 8a. Environmental transport, fate, and effects of liquefaction products.** Millemann, R.E. (Oak Ridge National Lab., TN (USA)). Nov 1984. Contract AC05-84OR21400. 83p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85003791.

Direct coal liquefaction is a developing technology for which detailed environmental studies have been limited and more complete information is needed for compliance with various Federal Acts. This paper is a critical review of the literature on environmental transport, fate, and effects of direct coal liquefaction products with emphasis on the SRC I and II, H-Coal, and Exxon Donor Solvent processes. It was done to assess the status of research that has been accomplished and to serve as a basis for planning future research programs. The review is organized around the following topics: (1) the initial issues that were believed to be important for the assessment of the transport, fate, and effects of direct coal liquefaction products; (2) the research done to address these issues; (3) the initial issues that were resolved by this research; and (4) additional or new research needs. 68 references, 3 figures, 12 tables.

6328 **(ORNL/FETEP—10) Environmental, health, and safety assessments for direct coal liquefaction. Volume 8b. Environmental transport, fate, and effects of atmospheric emissions.** Sigal, L.L. (Oak Ridge National Lab., TN (USA)). Nov 1984. Contract AC05-84OR21400. 96p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85003789.

Direct coal liquefaction is a developing technology for which detailed environmental studies have been limited and more complete information is needed for compliance with various federal acts. This paper is a review of the literature on environmental transport, fate, and effects of direct coal liquefaction atmospheric emissions with emphasis on the SRC I and II, H-Coal, and Exxon Donor Solvent processes. It was done to assess the status of research that has been accomplished and to serve as a basis for planning future research programs. The review is organized around the following topics: (1) the initial issues that were believed to be important for the assessment of the transport, fate, and effects of direct coal liquefaction atmospheric emissions; (2) the research done to address these issues; (3) the initial issues that were resolved by this research; and (4) additional or new research needs. 88 references, 1 figure, 14 tables.

6329 **(TNO-HMT—84-03759) Inventory and evaluation of the state of affairs on modelling of deposition and resuspension of fugitive coal dust.** Vermeulen, P.E.J. (Nijverheidsorganisatie TNO, Apeldoorn (Netherlands). Hoofdgroep Maatschappelijke Technologie). Jun 1984. 79p. (In Dutch). Nijverheidsorganisatie TNO, Hoofdgroep Maatschappelijke Technologie, Apeldoorn, Netherlands.

The dispersion of coal dust particles can only be calculated if the dry deposition velocity is known. This velocity indicates to what extent dust particles reaching the ground are actually 'retained'. Sehmel and Hodgson's method recommended for the determination of the dry deposition velocity above relatively smooth terrain such as grassland for example. Coal dust particles can also be removed from a dust plume by raindrops (wet deposition). It is concluded that for calculation of the wet deposition of particles in excess of 1 micron reliable methods are available. Deposited coal dust particles can be dispersed by the wind at another point of time, which is frequently denoted by resuspension. For the resuspension emission of dust particles from grassland an empirical correlation has been drawn up. It has been found that the resuspension emission from sites situated around a coal terminal is insignificant under normal conditions. In carrying out measuring campaigns on emission factors for example, due account should be taken of resuspension emissions, in particular with strong winds. Studies into the long-term effects of radioactive contaminants suggest that coal dust dispersed by the wind and subsequently deposited will mainly accumulate in the soil and not in the vegetation.

6330 **(TNO-HMT—84-06399) Inventory and evaluation of the international state of affairs on dispersion and dispersion models of fugitive coal dust.** Vermeulen, P.E.J. (Nijverheidsorganisatie TNO, Apeldoorn (Netherlands). Hoofdgroep Maatschappelijke Technologie). May 1984. 134p. (In Dutch). Nijverheidsorganisatie TNO, Hoofdgroep Maatschappelijke Technologie, Apeldoorn, Netherlands.

The influence of atmospheric turbulence on the dispersion of fine coal particles is similar to the influence on gaseous contaminants, provided the particles are small (100 micron or less), but under the influence of gravity the particles fall down. Due to such factors as impaction and filtration the particles are held to the ground. The overall transport to the ground is defined by means of the deposition velocity. Deposition velocity and velocity in free fall are not equal to one another. Mathematical dispersion models should therefore meet the requirement that the influences of gravity and dry deposition are individually modelled, with free fall velocity and deposition velocity as parameters. For particles in excess of 100 micron the influence of atmospheric turbulence is smaller for the larger particles. Dispersion of coal dust mainly takes place in currents that are influenced by obstacles. Mathematical dispersion models should be capable of accounting for the influences of obstacles on dispersion. It is found that the emission conditions (source strength, emission height) which are required as input parameters for mathematical models can only be tentatively estimated. It follows from an inventory of dispersion models that variants of the Gaussian plume model are available which are expected to be applicable to calculations of the dispersion of dust particles smaller than 100 micron. Preference is also given to a so-called partial-reflection model and to methods which have been derived from solutions of the dispersion equation for dust particles.

## 0110 Reserves And Exploration

6331 **(DOE/ET/14690—T2-Vol.1) Peat resources of Maine. Volume 1. Aroostook County.** Cameron, C.C.; Mullen, M.K.; Lepage, C.A.; Anderson, W.A. (Maine Dept. of Conservation, Augusta (USA). Maine Geological Survey). [1984]. Contract FG18-79ET14690. 112p. NTIS, PC A06/MF A01; GPO Dep. File Number DE85004196.

Bulletin 28.

In July 1979, the Maine Office of Energy Resources, in conjunction with the Maine Geological Survey, began the Maine Peat Resource Evaluation Program. The Program, which was funded by the US Department of Energy (DOE, was undertaken to determine the amount and location of fuel-grade peat in Maine. Two hundred thirty three areas containing peat deposits were evaluated under the Program. A total of 42 deposits covering 11,498 acres and containing 18,851,400 short tons (dry weight) of peat in Aroostook County have been evaluated under the Maine Peat Resource Evaluation Program. These deposits range in size from 30 to 1936 acres and in estimated resources from 48,000 to 3,872,000 short tons. Maps of individual deposits showing the distribution and depth of peat, core sites, and the surficial geology of the area adjacent to the deposits are shown in Figures 4-41. Cores showing the vertical distribution of peat and sediments as well as sample locations, and results of laboratory analyses are also included. 22 references, 41 figures, 3 tables.

6332 **(DOE/ET/14690—T2-Vol.2) Peat resources of Maine. Volume 2. Penobscot County.** Cameron, C.C.; Mullen, M.K.; Lepage, C.A.; Anderson, W.A. (Maine Dept. of Conservation, Augusta (USA). Maine Geological Survey). 1984. Contract FG18-79ET14690. 128p. NTIS, PC A07/MF A01; GPO Dep. File Number DE85004195.

Bulletin 29.

In July 1979, the Maine Office of Energy Resources, in conjunction with the Maine Geological Survey, began the Maine Peat Resource Evaluation Program. The Program, which was funded by the US Department of Energy (DOE), was undertaken to determine the amount and location of fuel-grade peat in Maine. Two hundred thirty-three areas containing peat deposits were evaluated under the Program. A total of 47 deposits covering 21,666 acres and containing 40,923,000 short tons (dry weight) of peat in Penobscot County have been evaluated under the Maine Peat Resource Evaluation Program. These deposits range in size from 35 to 3301 acres and in estimated resources from 45,000 to 6,994,000 short tons. Maps of individual deposits showing the distribution and depth of peat, core sites, and the surficial geology of the area adjacent to the deposits are shown in Figures 4 to 46. Cores showing the vertical distribution of peat and sediment as well as sample locations, and the results of laboratory analyses are also included. 22 references, 46 figures, 3 tables.

6333 **(DOE/ET/14690—T2-Vol.3) Peat resources of Maine. Volume 3. Piscataquis and Somerset Counties.** Cameron, C.C.; Mullen, M.K.; Lepage, C.A.; Anderson, W.A. (Maine Dept. of Conservation, Augusta (USA). Maine Geological Survey). 1984. Contract FG18-79ET14690. 134p. NTIS, PC A07/MF A01; GPO Dep. File Number DE85003759.

Bulletin 30.

In July 1979, the Maine Office of Energy Resources, in conjunction with the Maine Geological Survey, began the Maine Peat Resource Evaluation Program. The Program, which was funded by the US Department of Energy (DOE), was undertaken to determine the amount and location of fuel-grade peat in Maine. Two hundred thirty-three areas containing peat deposits were evaluated under the Program. A total of 49 deposits covering 12,952 acres and containing 22,683,000 short tone (dry weight) of peat in Piscataquis and Somerset Counties have been evaluated under the Maine Peat Resource Evaluation Program. These deposits range in size from 27 to 1344 acres and in estimated resources from 37,800 to 3,204,800 short tons. Maps of individual deposits showing the distribution and depth of peat, core sites, and the surficial geology of the area adjacent to the deposits are shown in Figures 4 to 52. Cores showing the vertical distribution of peat and sediment as well as sample locations, and the results of laboratory analyses are also included. 22 references, 52 figures, 3 tables.

6334 **(DOE/ET/14690—T2-Vol.4) Peat resources of Maine. Volume 4. Southern and western Maine.** Cameron, C.C.; Mullen, M.K.; Lepage, C.A.; Anderson, W.A. (Maine Dept. of Conservation, Augusta (USA). Maine Geological Survey). 1984. Contract FG18-79ET14690. 131p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE85004198.

In July 1979, the Maine Office of Energy Resources, in conjunction with the Maine Geological Survey, began the Maine Peat Resource Evaluation Program. The Program, which was funded by the US Department of Energy (DOE), was undertaken to determine the amount and location of fuel-grade peat in Maine. Two hundred thirty-three areas containing peat deposits were evaluated under the Program. A total of 46 deposits covering 11,853 acres and containing 21,930,200 short tone (dry weight) of peat in southern and western Maine have been evaluated under the Main Peat Resource Evaluation Program. These deposits range in size from 55 to 732 acres and in estimated resources from 55,000 to 1,864,000 short tons. Maps of individual deposits showing the distribution and depth of peat, core sites, and the surficial geology of the area adjacent to the deposits are shown in Figures 4 to 49. Cores showing the vertical distribution of peat and sediment as well as sample locations, and the results of laboratory analyses are also included. 22 references, 45 figures, 3 tables.

6335 **(DOE/ET/14690—T2-Vol.5) Peat resources of Maine. Volume 5. Washington County.** Cameron, C.C.; Mullen, M.K.; Lepage, C.A.; Anderson, W.A. (Maine Dept. of Conservation, Augusta (USA). Maine Geological Survey). 1984. Contract FG18-79ET14690. 146p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE85004197.

In July 1979, the Maine Office of Energy Resources, in conjunction with the Maine Geological Survey, began the Maine Peat Resource Evaluation Program. The Program, which was funded by the US Department of Energy (DOE), was undertaken to determine the amount and location of fuel-grade peat in Maine. Similar DOE/State Peat Resource Evaluation Programs are also being carried out in thirteen other states, including Alaska, Michigan, Minnesota, North Carolina, and South Carolina, whose programs began in 1979. Two hundred thirty-three areas containing peat deposits were evaluated under the Program. A total of 48 deposits covering 14,988 acres and containing 32,114,800 short tons (dry weight) of peat in Washington County have been evaluated under the Maine Peat Resource Evaluation Program. These deposits range in size from 40 to 2645 acres and in estimated resources from 40,000 to 6,953,000 short tons. Maps of individual deposits showing the distribution and depth of peat, core sites, and the surficial geology of the area adjacent to the deposits are shown in Figures 4 to 50. Cores showing the vertical distribution of peat and sediment as well as sample locations, and the results of laboratory analyses are also included. 22 references, 50 figures, 3 tables.

6336 (DOE/METC/SP—80-23, pp 64-81) **Rome Trough relationship to fracture domains, regional stress history and decollement structures.** Kulander, B.R.; Dean, S.L. Oct 1980. NTIS.

In US Department of Energy Morgantown Energy Technology Center report.

The Rome Trough, a major Appalachian basement structure, trends northeastward through western West Virginia from Kentucky into Pennsylvania. Its eastern flank, through Kanawha and adjoining counties is steepened by pronounced faulting. Total east margin relief from the trough axis to the crest of the central West Virginia arch is approximately 3000 M. (10,000 ft). Resulting basin configuration may have influenced past and present stress trajectories in Paleozoic rocks. Three coal fracture domains were mapped in S. central West Virginia. Here regional systematic fractures predate folding and strike N45W and N75-85E over the Rome Trough and central West Virginia arch respectively delineating 2 fracture domains. To the south and southwest of Kanawha County, a west-northwest trending boundary parallels the northern flank of the southern West Virginia Arch before curving to the northwest into Wayne County. This line delineates a third fracture domain. 24 references.

6337 **(NP—5770086) Anthracite deposits in the Lias of the Eastern Pontides in Turkey.** Yersel, H.G. (Technische Univ. Clausthal, Clausthal-Zellerfeld (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet). 8 Jul 1983. 60p. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE85770086.

Coal deposits which are classified to the Lias were found in the eastern Pontides in Turkey having a very high degree of carbonification in some regions. It is reported about the stratigraphical, tectronical and paleogeographical situation of the coal deposits and the degree of carbonification. The coal has to be regarded uneconomic due to its high ash content of 90-95%.

## 0120 Mining

*REFER ALSO TO CITATION(S) 0120006354*

6338 **(CONF-8305231—Absts.) Austrian mining day 1983.** (Bergmaennischer Verband Oesterreichs, Leoban). 1983. 25p. (In German). NTIS (US Sales Only), PC A02/MF A01. File Number DE85770095.

From Austrian mining day '83 meeting; Leoben, Austria (3 May 1983).

The presentations of the Austrian Mining Day 1983 concern the dump ore production and processing, alternative mining techniques in coal mining, modern mining plants, the use of crushing plants in solid rock open pits and the driving of a bunker shaft in the open pit. New developments of the mine surveying and deformation measurements of high accuracy in the rock are presented. Reports about the operation, development and management of the Salzach coal mining, the bauxite mining in Sierre Leone, the Steirean Erzberg and the bright coal mining in Fohnsdorf are given.

6339 **(NP—5770078) Mining foreman.** Fronz, M.; Peter, G. (Westfaelische Berggewerkschaftskasse, Bochum (Germany, F.R.); Sozialforschungsstelle Dortmund (Germany, F.R.)). 1983. 139p. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number DE85770078.

This collection is of extracts from the results of social scientific research into the subject of mining foremen. It covers the period between 1953 til 1982. 'Miner and Pit' brings to light the social conditions in a colliery from the perspective of the miners. 'The Sociology of the Working Climate' is a study for the interpretation of empirical investigations in large-scale enterprises 'Senior between Management and Workers' investigates the position and general opinions of mining foremen and master craftsmen. Kinds of Work Involving Technical Knowledge in Hard-Coal Mining' looks into the scope of work, co-operation together with technical and organisational charge. The conclusion is taken up by an investigation of 'The Reasons Why Students Discontinue Their Studies at the Mining College in Bochum'.

6340 **(NP—5770083) Deutscher Braunkohlen-Industrie-Verein e.V.; Annual report. Pt. 1-3.** (Deutscher Braunkohlen-Industrie-Verein e.V., Koeln (Germany, F.R.)). 1982. 34p. (In German). NTIS (US Sales Only), PC A03/MF A01. File Number DE85770083.

The annual report 1982 of the German Brown Coal Industry Association contains statements about the position of the brown coal mining in the energy economics in the Federal Republic of Germany, the other energy carriers and the power generation and the development of the brown coal mining areas in the Federal Republic of Germany. The report further contains statistical figures about the production and the use of brown coal in the Federal Republic of Germany.

## 0130 Transport And Handling

*REFER ALSO TO CITATION(S) 0130006299*

6341 **(DOE/PC/70805—T1) Fundamental studies of bulk flow of fine coal. Quarterly report, July 15, 1984-September 30, 1984.** Hogg, R.; Luckie, P.T. (Pennsylvania State Univ., University Park (USA). Coll. of Earth and Mineral Sciences). 1984. Contract FG22-84PC70805. 23p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85002618.

The primary aims of this research project are to investigate the procedures used for evaluating the flow behavior of fine coal and to conduct systematic studies of the relationship between flowability and the fundamental characteristics of the coal particles, with a view to the development of predictive models. An ancillary goal is to investigate the role of bulk flow in the performance of gas cyclones for coal dust collection. During the initial period of this research project, various aspects of the test work have been initiated, and methodologies for data analysis are being developed. Preliminary experiments are being conducted on the relationshipa between sample preparation and test reproducibility which is felt to be a limiting factor in the use of shear tests for evaluating flow characteristics. Development of improved statistical procedures for parameter estimation from test data is in progress. Problems in the application of measured flow characteristics to the design of materials handling systems are also being investigated. Preliminary calculations for the design of a gas cyclone system are in progress. 1 figure.

6342 **(DOE/PC/71503—T1) Explorations into thermodynamics analogies and critical points in reference to gas-solid transport.** Mathur, M.P.; Wildman, D.; Tuba, S.T.; Klinzing, G.E. (Pittsburgh Univ., PA (USA)). 1984. Contract FG22-84PC71503. 19p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85000816.

The use of analogies to explain transport processes is not new. The idea of borrowing concepts from thermodynamics and applying them to transport cases are also known. Experimental data from several investigators where the solid voidage has been determined experimentally have been analyzed to test the ability of a cubic van der Waals equation to represent the solid flow, gas flow and voidage. Using the van der Waals format phase diagrams have been constructed for a number of particulate systems which have been scrutinized. From this information the critical properties of the solids can be found. A generalized reduced properties plot has been constructed and has been shown to be unique in representing all the data. Exploration into the pressure drop domain has shown a relationship between the phase diagrams by an analytical approach. 9 references, 8 figures, 1 table.

6343 **(PML—1983-107) Heat generation of coal during storage. Investigations in 1982.** Heemskerk, A.H. (Nijverheidsorganisatie TNO, Rijswijk (Netherlands). Prins Maurits Lab.). 1983. 41p. (In Dutch). Nijverheidsorganisatie TNO, Prins Maurits Lab., Rijswijk, Netherlands.

The results of the investigations in 1982 into the heat generation of coal as a consequence of degradation, are reported. The heat generations of two types of Australian and American coal have been determined isothermally at several temperature levels. A direct relationship between the oxygen concentration and the heat generation has been established for oxygen concentrations between 10 and 100%. Only a marginal effect of the particle size on the heat generation has been found. The moisture balance in the coal plays a vital role in the self-heating process. According to adiabatic experiments the cooling effect of evaporating moisture is closely related to the varying ventilation rate, while also the relative humidity of the air is involved in the process.

6344 **(PML—1983-112) Exploratory study of the possible (dust) explosion hazards of transport, storage and handling of coal in the Netherlands.** van Laar, G.F.M.; Zeeuwen, J.P.; van Dijen, D.J.G.; Ruygrok J.P.J. (Nijverheidsorganisatie TNO, Rijswijk (Netherlands). Prins Maurits Lab.). 1983. 178p. (In Dutch). Nijverheidsorganisatie TNO, Prins Maurits Lab., Rijswijk, Netherlands.

At the request of Project Office for Energy Research, BEOP, an orientating study has been conducted into the possible (dust) explosion hazards during transport, storage, transhipment, handling and use of coal in the Netherlands. The study comprises a survey of the explosion properties of coal dust, safety measures against explosions, and the explosion hazards in the different systems of transport, storage, transhipment, handling and use of coal. The present and future situation are described. This study concludes with guidelines and recommendations to promote explosion safety. From the study it appears that explosions are possible during transport, storage, transhipment, handling and use of coal. By taking suitable measures explosions can be avoided in most cases or the consequences can be limited should an explosion occur.

6345 **Coal storage hopper with vibrating screen agitator.** Daw, C.S.; Lackey, M.E.; Sy, R.L. (to Dept. of Energy). US Patent 4,470,525. 11 Sep 1984. Filed date 27 Apr 1982. vp.

The present invention is directed to a vibrating screen agitator in a coal storage hopper for assuring the uniform feed of coal having sufficient moisture content to effect agglomeration and bridging thereof in the coal hopper from the latter onto a conveyor mechanism. The vibrating screen agitator is provided by a plurality of transversely oriented and vertically spaced apart screens in the storage hopper with a plurality of vertically oriented rods attached to the screens. The rods are vibrated to effect the vibration of the screens and the breaking up of agglomerates in the coal which might impede the uniform flow of the coal from the hopper onto a conveyer.

## 0140 Combustion

*REFER ALSO TO CITATION(S) 0140006310, 6311, 6737*

6346 **(BNL—35395) Progress in the acceptance of new coal utilization technologies.** Lamontagne, J.; Kaufman, D.Z. (Brookhaven National Lab., Upton, NY (USA); Department of Energy, Washington, DC (USA)). Sep 1984. Contract AC02-76CH00016. 33p. (CONF-840971—6). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85003499.

From 1. annual Pittsburgh coal conference; Pittsburgh, PA, USA (17 Sep 1984).

Interest in clean and economic methods for coal utilization was stimulated by the sharply higher oil prices and environmental quality legislation of the 1970's. Considerable investment in research and development by both the public and private sectors has led to the development of a diverse array of technologies, several of which are now in the early stages of commercialization. This report summarizes the progress to date in commercial acceptance of several of the most important of these emerging technologies, and speculates on their prospects for the future. Factors influencing acceptance are discussed, and various measures of market penetration are applied in instances where appropriate. 31 references.

6347 **(CONF-841121—11) Combustion of calcium treated coals.** Chang, K.K.; Flagan, R.C.; Gavalas, G.R.; Sharma, P.K. (California Inst. of Tech., Pasadena (USA); Jet Propulsion Lab., Pasadena, CA (USA)). 1984. Contract FG22-83PC60801. 30p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85003760.

From AIChE annual meeting; San Francisco, CA, USA (25 Nov 1984).

The combustion of calcium-exchanged coals was studied in laminar flow and fluid bed reactors under strongly fuel-lean conditions. The purpose of the study was to understand the nature of release and capture of sulfur oxides in the presence of finely dispersed calcium oxide and explore the effectiveness of calcium-exchange pretreatment for sulfur emission control in coal combustion. The experimental variables were residence time, oxygen concentration, furnace temperature and amount of calcium-additive. The two coals used in this study were PSOC 623, a Texas lignite, and PSOC 680, an Indiana high volatile B bituminous. Analysis of the experimental data indicated that sulfur capture increased as residence time or oxygen concentration increased. The results also showed that sulfur capture was approximately proportional to the Ca/S ratio of the coals. 8 references, 10 figures, 5 tables.

6348 **(DOE/PC/40802—T1) Catalytic combustion of coal and synthetic fuels. Final technical report, September 1981-August 1984.** Klier, K.; Herman, R.G.; Simmons, G.W. (Lehigh Univ., Bethlehem, PA (USA). Center for Surface and Coatings Research). Oct 1984. Contract FG22-81PC40802. 80p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85000036.

Insight into the transformations of the mineral matter and organic radicals in coal during air oxidation treatment has been obtained. It has been demonstrated that calcium-containing minerals and iron-containing minerals act as catalytic centers for the oxidation of the coal matrix, and this is first exhibited as surface pitting of the coal particles. The pyrite initially behaves as an oxygen trap to form sulfates, which subsequently decompose via transient intermediates to yield sulfur dioxide and hematite. It has been shown that the concentration of free radicals formed in Illinois No. 6 coal under mild conditions depends on the presence and state of the sulfur-containing iron compounds in the coal. The complete coal oxidation process can be carried out in a fluidized bed rather isothermally at temperatures below 400°C. It has been demonstrated that surface-held $FeSO_4$ initiates oxidative pitting attack of graphite surfaces and that the attack is propagated by channelling along preferred crystallographic directions in graphite surface. 88 references, 19 figures, 5 tables.

6349 **(DOE/PC/50266—7) Vaporization and devolatilization of coal water sprays. Seventh quarterly report for the period ending May 11, 1984.** Chigier, N.; Meyer, P.L. (Carnegie-Mellon Univ., Pittsburgh, PA (USA). Dept. of Mechanical Engineering). 1984. Contract FG22-82PC50266. 16p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85002488.

The objective of this research is to investigate fundamental processes leading to combustion of coal-water slurries. Investigations of the vaporization and devolatilization of coal-water slurry sprays are underway in order to learn about the fundamental processes leading to combustion of coal-water slurries. In the three months reviewed here photographic analysis of the Parker-Hannifin atomizer has continued. High magnification photographs, which show droplets/particles as small as 10 to 15 μm in size, have been taken of the spray at the atomizer's design conditions. Characterization of the Coen No. 1MV atomizer coal-water slurry spray has also begun. We will use these studies to select an atomizer for more detailed studies of droplet/particle sizes and velocities. 9 figures.

6350 **(DOE/PC/60409—T3-Vol.1) Feasibility evaluation of wet oxidation for combustion of coal slurries. Volume I. Discussion and reference list. First quarterly report, 31 August-30 November 1983.** Engleman, V.S.; Kirstein, B.E.; deLesdernier, D.L. (Science Applications, Inc., La Jolla, CA (USA)). 1983. Contract AC22-83PC60409. 44p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85003868.

The use of wet oxidation processes for coal (coal slurry) combustion is being investigated. The first task is the development of a supporting technology data base. This report describes the initial efforts in developing this data base. Computerized literature searches of the Energy Database, Chem Abstracts, and Engineering Index have been performed and are included in Appendices A-K. The more pertinent references have been placed in a computer file. These citations are presented in Appendix L in this volume. (DMC)

6351 **(ECN—83-105) Optical image analysis of fine coal particles as an aid in optimizing combustion in a fluidized bed.** Vleeskens, J.M. (Netherlands Energy Research Foundation, Petten). 1983. 20p. Netherlands Energy Research Foundation, Petten.

Heat transfer losses are supposed to prevent the ignition of coal particles below a critical diameter. If the major part of char in the fly ash of a fluidized bed combustor (FBC) is below this size, recirculation to the same combustion zone is of no use. An optical image analysis system (TAS, Leitz) was used to analyze the size distribution of coal particles after a single pass through a fluidized bed combustor. The TAS system discriminates between highly reflecting coal or char particles and low reflectance ash. The maximum size as determined for different coal-chars in the 60 kW AFBC facility of ECN was about 100 micrometer. Literature data suggest that further combustion of these small particles is not feasible under the same conditions of temperature and flow. (Available from ECN, PO Box 1, NL-1755 ZG Petten)

6352 **(EPRI-CS—3413-Vol.3) Coal-water-slurry evaluation. Volume 3. Burner test results. Final report.** Eckhart, C.F.; Lindstrom, G.D. (Babcock and Wilcox Co., Alliance, OH (USA). Research Center). Nov 1984. 49p. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $10.00. File Number TI85920121.

This is the third of three volumes describing a multi-phase, coal-water slurry (CWS) test program. This volume summarizes the results of tests of a single, full-scale 15-million Btu/hr burner to be used in a multi-burner industrial boiler demonstration of CWS at a DuPont plant in Memphis, Tennessee. The burner was tested at the Babcock & Wilcox Company (B & W) Research Center in Alliance, Ohio. Data was taken and observations were made relative to the burner performance and firing stability of CWS as affected by the type of atomizing media (air versus steam), load variations, method of preheating combustion air (direct versus indirect), and excess air level. Base data was also obtained with No. 6 fuel oil. The burner performance was found to be acceptable. 10 figures, 3 tables.

## 0150 Marketing And Economics

*REFER ALSO TO CITATION(S) 0150006741*

6353 **(NP—5770085) Verein Deutscher Kohlenimporteure: Annual report 1983.** (Verein Deutscher Kohlenimporteure e.V., Hamburg (Germany, F.R.)). Jun 1984. 95p. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE85770085.

The annual Report of the Association of German Coal Importers presents a review of the total economic development in Germany, the energy economics in the European Community and Germany and an outlook of the electricity, heat and coking coal markets in Germany. The energy supply situation in different coun-

tries and regions in the report year is given. The report further contains figures about the above mentioned subjects and particularly the import and export of bituminous coal in the world trade.

6354 **(NP—5770087) Aktionsgemeinschaft Deutsche Steinkohlenreviere GmbH: Annual report 1983.** (Aktionsgemeinschaft Deutsche Steinkohlenreviere G.m.b.H., Duesseldorf (Germany, F.R.)). 1984. 61p. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE85770087.

The annual report of the Activity Community of German Coal Mines, Dusseldorf presents an overview of the energy economics in the Federal Republic of Germany and particularly about the development in bituminous coal mining. 1.8 Mio sqm of landed property were bought and sold further or released for the establishment or extension of plants and for the development of industrial areas in order to support the improvement of the economic structure in 1983. Grants for mining damages were also given.

### 0160 Health And Safety

*REFER ALSO TO CITATION(S) 0160006327, 6344, 7512*

6355 **(PB—80-216880) Symposium on energy and human health: human costs of electric power generation.** (Environmental Protection Agency, Washington, DC (USA). Office of Research and Development). Mar 1979. 580p. (CONF-7903107—). Environmental Protection Agency, Office of Research and Development, Washington, DC, USA.

From Symposium on energy and human health: human costs of electric power generation; Pittsburgh, PA, USA (19 Mar 1979).

Papers were presented on the following topics: occupational problems in coal and uranium mining; methodological problems in detecting health effects from fuel cycle pollutants; health aspects of fossil-fuel power plants; health aspects of transportation and transmission; health problems in nuclear power generation; and future areas of concern (potential health problems in the production of synthetic fuels from coal, long term health implications of radioactive waste disposal, and areas of uncertainty in estimates of health risks)

## 02 PETROLEUM

*REFER ALSO TO CITATION(S) 0200006254*

### 0201 Reserves

*REFER ALSO TO CITATION(S) 0201006373*

### 0202 Geology And Exploration

6356 **(DOE/ET/12130—113) Occurrence of oil and gas in Devonian shales and equivalents in West Virginia.** Schwietering, J.F. (Department of Energy, Washington, DC (USA)). Mar 1981. 59p. NTIS.

During the Devonian, an epicontinental sea was present in the Appalachian basin. The Catskill Clastic Wedge was formed in the eastern part of the basin by sediments derived from land along the margin of the continent. Three facies are recognized in the Catskill Clastic Wedge: (1) a red-bed facies deposited in terrestrial and nearshore marine environments; (2) a gray shale and sandstone facies deposited in a shallow- to moderately-deep marine environment; and (3) a dark-gray shale and siltstone facies deposited in the deepest part of the epicontinental sea. Oil and natural gas are being produced from Devonian shales in the western part of West Virginia and from upper Devonian sandstones and siltstones in the north-central part of the state. It is suggested that in addition to extending known areas of gas production, that drilling for natural gas be conducted in areas underlain by organic-rich shales and thick zones of interbedded siltstone and shale in the Devonian section in central, southern, and western West Virginia. The most promising areas for exploration are those areas where fractures are associated with folds, faults, and lineaments. 60 references.

6357 **Using a sonic technique to estimate in-situ stresses.** Mao, N.H.; Costantino, M.S.; Hanson, J.M.; Sweeney, J.J. (Lawrence Livermore National Laboratory). *Society of Petroleum Engineers of A.I.M.E. (American Institute of Mining, Metallurgical and Petroleum Engineers), Paper;* **SPE/DOE/GRI 12850**: 201-208(May 1984). (CONF-8405120—).

From SPE/DOE/GRI unconventional gas recovery symposium; Pittsburgh, PA, USA (13 May 1984).

This paper presents the results of a three-year research effort to develop a technique for estimating in situ stresses by measuring stress-induced velocity anisotropy around a borehole. Relevant parameters required to make the estimate were identified and measured in the laboratory on a 35.6 cm (14.0 in) cube of Nugget sandstone with a 10.2 cm (4.0 in) diameter hole, under biaxial loading. Two pairs each of radially and tangentially polarized transducers were placed inside the hole with displacement directions either parallel or perpendicular to the principal stress directions. With this configuration, relative travel times were measured by both a pulsed phase-locked loop technique and a cross correlation of digitized waveforms. The biaxial velocity data were used to back-calculate the applied stress. The standard deviation of the differences between the calculated and applied stresses is 0.62 MPa (90 psi) for a stress level up to 8.63 MPa (1250 psi).

### 0203 Drilling And Production

*REFER ALSO TO CITATION(S) 0203006310, 6393*

6358 **(DOE/BC/10033—2) Evaluation of the North Burbank Unit tertiary recovery pilot test.** Tracy, G.W.; Dauben, D.L. (Department of Energy, Washington, DC (USA)). Aug 1982. 31p. NTIS.

A review of the performance of the Phillips North Burbank micellar-polymer flood has been completed. The projected ultimate recovery is estimated to be ca 300,000 bbl, which is approximately one-half of the initial prediction made by Phillips. Although oil recovery has been less than expected, sufficient additional oil has been recovered to consider the project technically successful. The lower-than-expected oil recovery is attributed principally to high sulfonate losses. Loss of the sulfonate appears to be the result of significant adsorption to the oil-wet pore surfaces and mixing of micellar fluids with in-place water, which is of high salinity and hardness. Contact of the sulfonate with the high concentration of calcium ions creates calcium sulfonate, which either precipitates as an insoluble phase or partitions into the oil phase. Sulfonate partitioning would have created an upper-phase microemulsion, which cannot be displaced easily by water due to the relatively high interfacial tension. 11 references.

6359 **(DOE/BC/10310—20) Measurement and correlation of conditions for entrapment and mobilization of residual oil. First annual report.** Morrow, N.R.; Chatzis, I.; Thuraisingham, S.T.; Kuntamukkula, M.; Lim, H.T. (Department of Energy, Washington, DC (USA)). Sep 1982. 63p. NTIS.

The first year's progress of a project having 4 major task areas is covered. Substantial progress has been made in each task area, and it is expected that all tasks will be completed during the second year of this project. The first task is to establish the limits of reliability of laboratory waterflooding as an evaluation tool. This work is being extended to the wetting properties of crude oils and selected aspects of core flooding procedure, such as the effects of overburden pressure and the properties of displaced and displacing fluids. The second task concerns the effects of high capillary number flows on trapping phenomena and residual oil saturation. The third task deals with mechanisms of mobilization and entrapment. Detailed accounts have been presented of work on relative permeability at reduced residual oil saturations and for factors which affect the magnitude and distribution of residual oil. Work on the fourth task concerns the detailed structure of residual oil. The technique of using a nonwetting phase which will solidify and can be separated from the rock has been applied. 32 references.

6360 **(DOE/BC/10327—21) Development and verification of simplified prediction models for enhanced oil recovery application: Steam Flood Predictive Model.** Aydelotte, S.R.; Paul, G.W. (INTERCOMP Resource Development and Engineering, Inc., Houston, TX (USA); USDOE Bartlesville Project Office, OK (USA)). Oct 1984. Contract AC19-80BC10327. 119p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE85000101.

To facilitate the screening and evaluation of reservoirs for the application of steam drive as an enhanced oil recovery process, a simplified predictive model for steam drive performance has been constructed. This model is an extension of existing analytical heat balance models to include fractional flaw characteristics, vertical and areal sweep effects, steam injectivity, and heat losses in wellbores and surface pipes. An economic analysis package is included in the model to allow for estimation of key costs and benefits of potential steam drive projects, and to calculate project profitability. An extensive set of defaults are included to allow execution of the model when only minimal data are available. The Steam Flood Predictive Model (SFPM) is described and demonstrated in this report. 43 references, 22 figures, 9 tables.

6361 **(DOE/BC/10344—4) Investigations of enhanced oil recovery through use of carbon dioxide. First annual report, October 1, 1980-September 30, 1981.** Kimbler, O.K.; Hoshman, R.M.; Monger, T.G.; McMullen, J.H.; Whitehead, W.R. (Department of Energy, Washington, DC (USA)). Jul 1982. 60p. NTIS.

Extensive modifications in both physical facilities and experimental equipment have extended capabilities in the area of low flow rate and gravity stable displacements. Consolidated core floods may be made now at high water saturations in 6-ft Berea sandstone cores to permit the study of $CO_2$ injection as a tertiary recovery process. All displacements during the period have involved reconstituted crude from the Brookhaven Field (Mississippi). These consisted of 2 runs in 6-ft Berea cores and 15 runs in 20-ft sand packs. Based upon these data, it is concluded that (1) a second (presumed liquid) phase develops at 109 F which consists of $CO_2$ and C17-C28 hydrocarbons and is not miscibly displaced, (2) $CO_2$ can bank up discontinuous residual oil in a watered-out system, (3) an increase in displacement temperature causes a significant increase in minimum miscibility pressure, and (4) definitive interpretation of compositional data can be made only when such data are taken during gravity stable displacements.

6362 **(DOE/BETC/OR—14) Systematic study of metal ion sorption on selected geologic media. Annual report, October 1978-December 1979. Part 1.** (USDOE Bartlesville Energy Technology Center, OK). Jun 1980. 85p. NTIS.

Results of research in selection of multiple tracers for enhanced oil recovery systems and ion exchange characteristics of enhanced oi recovery systems concerned with alkaline earth ion-alkali ion equilibria on clay minerals are summarized. An extensive study was completed of the distribution of Na(I) and Ca(II) ions between a common clay, montmorillonite, as well as several other clays, and a series of solutions of constant total ionic strength with varying ionic strength fraction of sodium. Equilibrium quotients for the exchange of sodium and calcium were then calculated and the effects of solution composition, of solution phase activity coefficients, of ionic strength, of degree of purification, and of source of clay were investigated. Distribution coefficients for Sr(II) were determined for a variety of conditions on various clay minerals and oxides. In general for clay minerals, the values of DSR decrease sharply independent of pH. 22 references.

6363 (DOE/ET/2628—1, pp 27-44) **Enhanced oil recovery from heavy oil reservoirs. Heavy oil recovery from traditional reservoir settings.** Stokes, D.D. Jul 1980. NTIS.

In US Department of Energy Fossil Energy report.

The features that make steam an attractive recovery process are discussed. Most important are the dramatic viscosity reduction and stability of displacement that lead to good sweep efficiency and high recovery. Process stability is enhanced by high permeability and formation dip. Other items (large pore volumes of steam, distillation effects, interfacial tension reduction, and pyrolysis) lead to low residual saturations that again lead to high recovery efficiency. Two fields in the San Joaquin Valley, where conditions are good for high recovery efficiency, are discussed in some detail.

6364 (DOE/ET/2628—1, pp 8-11) **Enhanced oil recovery from heavy oil reservoirs.** Doscher, T.M. Jul 1980. NTIS.

In US Department of Energy Fossil Energy report.

A history is given of heavy oil production. The invention of the steam soak technique in the field and its use in the production of heavy oil in California and Venezuela is discribed. Since research must be conducted at such a sophisticated level to be able to be extrapolated to the field, and since subsurface conditions are so difficult to replicate in the laboratory, the author urges that research be conducted with well-monitored field operations. It must be done on the strength of intuition and inference of trained, yet visionary, technologists.

6365 (DOE/ET/2628—1, pp 45-62) **Enhanced oil recovery from heavy oil reservoirs. Using thermal recovery in difficult reservoir settings.** Martin, W.L. Jul 1980. NTIS.

In US Department of Energy Fossil Energy report.

As there are only a few heavy oil reservoirs in the US that could be considered ideal for the thermal recovery, operators have been forced to develop technology to fit the reservoirs available to them. There are no routine applications of thermal recovery processes. Some common problems exist that have considerable impact on the future of thermal oil recovery, particularly for the marginal reservoirs. These problems are summarized in 3 categories: reservoir problems, economics, and technical difficulties. The highest priority research need is for improved areal and vertical conformance and for improved recovery from by-passed zones in steamflood and fireflood patterns.

6366 (DOE/ET/2628—1, pp 12-26) **Enhanced oil recovery from heavy oil reservoirs. State-of-the-art review.** Lee, W.D. Jul 1980. NTIS.

In US Department of Energy Fossil Energy report.

Enhanced oil recovery using the steam drive method in California is discussed. The Monte Cristo I property in the Kern River oil field is used as a case history. Although significant additional oil can be recovered by steam drive, the present state-of-the-art may leave almost as much oil behind as it recovers. Additional understanding of the basic reservoir factors and geology, refinement of data gathering instruments, improved steam usage and generation, and better well and surface equipment must be developed if the large amount of additional oil available from heavy oils is to be recovered economically. This becomes even more critical as the move is made from the shallow reservoirs to the deeper, heavy-gravity fields that still have not been adequately exploited.

6367 (DOE/ET/2628—1, pp 157-179) **Enhanced oil recovery from light oil reservoirs. Carbon dioxide in carbonates and sandstone.** Stalkup, F. Jul 1980. NTIS.

In US Department of Energy Fossil Energy report.

Carbon dioxide flooding is studied in the carbonate reservoirs in the Permian basin of west Texas and east New Mexico. The major advantage of this process are its simplicity, the attainable miscibility pressures, and the potential for a large carbon dioxide supply at acceptable cost from natural deposits. Graphs show the displacement of a west Texas oil by carbon dioxide at various pressures, and the recovery of residual oil by continuous injection of carbon dioxide. The factors affecting displacement efficiency are discussed: phase behavior, micro/macroscopic bypassing, extraction of bypassed oil, and oil trapping by water. A map locates field test locations of carbon dioxide flooding in sandstone carbonate reservoirs.

6368 (DOE/ET/2628—1, pp 265-272) **Enhanced oil recovery from special target reservoirs. The challenge of recovering oil from fractured sandstones.** Elkins, L.F. Jul 1980. NTIS.

In US Department of Energy Fossil Energy report.

There is not much potential of tertiary recovery of oil from fractured sandstone reservoirs. For any tertiary oil recovery process to work it is necessary to displace oil out of the rock matrix. In a highly fractured reservoir this means displacing oil out of a non-

uniform underground rock pile. The Spraberry is an outstanding example; its performance during both primary production and secondary waterflood has been studied for nearly 30 years. Work done at Spraberry is described.

6369 (DOE/ET/2628—1, pp 119-129) **Enhanced oil recovery from light oil reservoirs. Chemical flooding and thermal methods.** Poettmann, F.H. Jul 1980. NTIS.

In US Department of Energy Fossil Energy report.

Thermal recovery is the largest contributor among enhanced recovery techniques, with steam injection predominating. However, continued expansion of steam injection has experienced a setback when some California operations were forced to shut down because of emission problems. The number of active chemical floods has increased significantly in the last 5 to 6 years. In surfactant-polymer flooding there are approximately 1200 to 1400 acres now under flood. Micellar-polymer flooding is discussed, including screening criteria for micellar-polymer flooding and range of oil field characteristics for current Maraflood projects. A discussion of the difficulties of enhanced oil recovery includes economic sensitivity data.

6370 (DOE/ET/2628—1, pp 239-264) **Enhanced oil recovery from special target reservoirs. Improving recovery from offshore reservoirs.** Thurber, J.L. Jul 1980. NTIS.

In US Department of Energy Fossil Energy report.

The offshore area considered in this study is offshore Gulf of Mexico. The offshore oil reservoirs are considered special targets because of unique operating problems which require special consideration in the planning and execution of enhanced oil recovery processes. The special characteristics are discussed. A screening analysis indicates only chemical flooding and carbon dioxide flooding offer reasonable hope for commerical success. Problem areas and possible advantages of each process are investigated. A discussion of future studies and research is included.

6371 (DOE/ET/2628—1, pp 130-156) **Enhanced oil recovery from light oil reservoirs. Polymer assisted water flooding and alkaline flooding.** Chang, H.L. Jul 1980. NTIS.

In US Department of Energy Fossil Energy report.

Polymer flooding and alkaline flooding are treated separately in this study. Work with 2 types of polymers is reported - a synthetic polyacrylamide and a biologically produced xanthan gum. Field test data are presented. Technical difficulties and economic data are included. Polymer flooding should be applied early in the life of the field, and ultimate recovery is in the range of 300 to 500 million bbl. Alkaline flooding considers the use of sodium hydroxide, sodium silicate, and sodium carbonate. The largest problem in alkaline flooding is chemical losses from adsorption, neutralization, and ionic reactions. Caustic consumption by pure minerals and by reservoir rocks is tabulated. Chemical and polymer costs are compared.

6372 (DOE/ET/2628—1, pp 275-282) **Enhanced oil recovery from special target reservoirs. EOR potential for the North Slope.** van Poollen, H.K. Jul 1980. NTIS.

In US Department of Energy Fossil Energy report.

Information is presented primarily on the Prudhoe Field, which is half gas, half oil. The oil in place is approximately 20 billion bbl. The amount of solution gas is 14 TCF; the total gas in place is approximately 20 TCF; and the amount of condensate in the gas is estimated to be 800 million bbl. The gas contains a large amount of $CO_2$, approximately 12%. The reservoir is at a depth of 9000 ft. Possibilities for enhanced oil recovery are discussed in terms of natural $CO_2$ and LPG.

6373 (DOE/ET/2628—1, pp 92-101) **Enhanced oil recovery from light oil reservoirs.** Elkins, L.E. Jul 1980. NTIS.

In US Department of Energy Fossil Energy report.

Projections of enhanced oil recovery from light oil reservoirs are presented. A table of US reserves (without Alaska) shows original oil in sandstone, carbonate, and other reservoirs; ultimate recovery without enhanced oil recovery; and the resource target for enhanced oil recovery. A projection shows how daily average enhanced oil recovery might build up from 1975 to 2015. Projects also are made of future crude oil production and the split of enhanced oil recovery by thermal, carbon dioxide miscible, and chemical methods.

6374 (DOE/ET/2628—1, pp 102-118) **Enhanced oil recovery from light oil reservoirs. State-of-the-art review.** Blackwell, R.J. Jul 1980. NTIS.

In US Department of Energy Fossil Energy report.

This review concentrates on the commercial potential and the future of enhanced oil recovery from light oil reservoirs. Much of the discussion is based on the 1976 study published by the National Petroleum Council. A graph summarizes the incremental ultimate recovery, in billions of barrels of stock tank oil, as a function of oil price in dollars per billion barrels expressed in constant 1976 dollars. The ultimate recovery estimates include all oil produced from projects with a calculated rate-of-return of 10% or greater (surfactant flooding, polymer flooding, alkaline waterflooding, carbon dioxide miscible processes, and thermal recovery). Estimates of potential producing rates in millions of barrels of stock tank oil per day as a function of time are provided. The 2 major processes for recovery, surfactant and miscible carbon dioxide flooding, are discussed in some detail.

6375 (DOE/ET/2628—1, pp 180-197) **Enhanced oil recovery from light oil reservoirs. Review of technologies and depth limitations.** Geffen, T.M. Jul 1980. NTIS.

In US Department of Energy Fossil Energy report.

Increasing depth leads to higher temperature, higher pressure, older formations, and higher saturations of natural formation waters. In addition, increasing depth leads to lower porosity, lower permeability, lower oil saturation after a primary recovery, and higher water salinities. Greater depth translates into greater costs and risks. Graphs illustrate the following: effect of temperature and pressure on the type of hydrocarbon found in reservoirs, maximum temperature at which liquid hydrocarbons were recovered from reservoirs of various ages, porosities and permeabilities in common reservoir rock, depth effects on in-place oil and gas, effect of pressure on pore volume and on permeability, temperature vs. carbon dioxide minimum miscibility pressure, and thermal degradation of polyacrylamide at high temperatures.

6376 (DOE/ET/12056—22) **Laboratory combustion tube studies. Final report.** Fassihi, M.R.; Ramey, H.J. Jr.; Brigham, W.E. (Department of Energy, Washington, DC (USA)). Aug 1982. 95p. NTIS.

The importance of various process variables in in situ combustion was assessed through regular combustion tube runs using 4 different crude oils. Following Gates and Ramey, the correlation of oil recovered-volume burned was found to be an effective tool in prediction of combustion tube oil recovery. Hence, the range of applicability of this correlation was extended to higher gas saturations. To study the fuel availability and the frontal behavior more closely, some runs in heterogeneous packs were conducted using 2 or 3 consecutive zones of oil sand and water sand. It was found that distillation and clay content have profound effects on burning front temperature. Correlations were obtained for volume burned as a function of oil produced and initial gas saturations. The method for measurement of burning front thickness also is discussed.

6377 (DOE/ET/12056—24) **SUPRI (Stanford University Petroleum Research Institute) Heavy Oil Research Program. Fourth annual report, October 1, 1979-September 30, 1980.** Brigham, W.E. (Department of Energy, Washington, DC (USA)). Jul 1982. 80p. NTIS.

This fourth annual report on the Stanford University Petroleum Research Institute (SUPRI) summarizes all the SUPRI effort since its creation in 1976. The main objective of SUPRI is to conduct research and development related to enhanced recovery of heavy oil. The research conducted is intended to be directly useful to the oil industry, particularly in California, where much of the oil reserve is in the form of heavy oil. The most effective means of recovery of heavy oils is the application of the thermal recovery techniques, such as injection of steam or hot water into an oil reservoir, or in situ combustion of oil. Hence, the research projects undertaken at SUPRI are aimed at increasing understanding of the various thermal recovery techniques, and improving the effectiveness of such techniques. 62 references.

6378 **(DOE/ET/12056—31) Transient pressure analysis in composite reservoirs.** Tang, R.W.K.; Brigham, W.E. (Department of Energy, Washington, DC (USA)). Aug 1982. 131p. NTIS.

The problem of fluid flow in a radially composite reservoir is discussed. Recently published was the most general analytic solution available thus far. That analytic solution is analyzed, and the results are presented. The solution is dependent upon the following dimensionless parameters (if well-bore storage and skin effect are neglected): (1) dimensionless time based on the discontinuity radius, (2) the dimensionless discontinuity radius, (3) the mobility ratio, and (4) the diffusivity ratio. The range of parameters used in generating the results include dimensionless radius time of 0.01 to 10,000; mobility ratio of 1 to 1000; and diffusivity ratio of 1 to 200. The results were analyzed graphically and numerically. The results feature an infinite acting period followed by a transition period before the start of the second infinite acting period. 20 references.

6379 **(DOE/ET/12065—26) Enhanced oil recovery by improved waterflooding. Second annual report.** Boghossian, D.M.; Allen, M.; Castor, T.; Scriven, T. (USDOE San Francisco Operations Office, Oakland, CA). Aug 1980. 178p. NTIS.

Energy Resources Co. Inc. is currently operating a pilot polymer improved waterflood of the Storms Pool, a sandstone reservoir in the Illinois Basin. The polymer selected, based on laboratory comparisons of 10 different products under simulated reservoir conditions, is a xanthan-type polysaccharide polymer. Laboratory work included preliminary testing of biocides and oxygen scavengers. Development of the pilot area continued with the completion of the injection facility. Preliminary simulation was begun to determine the effect of polymer adsorption, field-wide drift, and other conditions on eventual production. An injection strategy will be determined based on these results. A complete environmental assessment of the project was made and proper containment and disposal facilities were added to the design of the injection system.

6380 **(DOE/MC/05301—86) Rock Creek carbon dioxide pilot project. Annual report, July 1980-June 1981.** King, P.E. Jr. (Department of Energy, Washington, DC (USA)). Sep 1982. 72p. NTIS.

The Rock Creek $CO_2$ project was initiated in 1976 under an ERDA-Pennzoil cost sharing contract. Wells were drilled to develop the 19.65 acre dual 5-spot pilot. Water was injected into the Big Injun formation to pressurize the reservoir and to observe the waterflood response, which was a sharp production kick. Recovery of oil during this time was 11,084 bbl or 564 bbl/acre. $CO_2$ injection began in February 1979. By June 1980, 23,842 tons had been injected. A 1.55-acre 4-spot min-pilot was developed, and an additional 12,000 tons of $CO_2$ was purchased. To date, an effective $CO_2$ volume equivalent to 10% of the total pore volume has been injected into the original pilot injection wells. Currently, 5 wells are on water injection, and the 3 mini-pilot injection wells are injecting $CO_2$. These 2 wells will continue $CO_2$ injection until an effective volume of $CO_2$ equivalent to ca 25% of the total mini-pilot pore volume has been injected. All of the wells then will remain on water injection until the miscible $CO_2$ displacement mechanism has been evaluated.

6381 **(DOE/SAN/1000—3) Paris Valley Combination Thermal Drive Pilot Demonstration Test. Final report.** Shipley, R.G. Jr.; Meldau, R.F.; White, P.D.; Patek, J.W. (USDOE San Francisco Operations Office, Oakland, CA). Sep 1980. 212p. NTIS.

Husky Oil Co. initiated a wet combustion pilot within the Paris Valley Field, Montery County, California, in January 1975, to determine the technical and economic feasibility of this enhanced recovery process within a sandstone reservoir having a very viscous crude. Cyclic steaming also was performed and evaluated. Due to the slow oil production rates, which were not capable of offsetting the high operating costs, the pilot was terminated during March 1979. The formation tested was the Ansberry Sand, found at an average depth of 800 ft. The Ansberry Sand is separated into 3 distinct zones (upper, middle, and lower lobes); the gross sand thickness is approximately 100 ft with the net oil sand thickness ranging from 5 to 90 ft in the pilot area. At the reservoir temperature of 87 F, the oil viscosity varies from 23,000 cp in the lower lobe to 227,000 cp in the upper lobe. The pilot was designed to operate within 5 staggered line-drive patterns. Eighteen producing wells, 5 air injectors, and one water disposal well were drilled. Two temperature observation wells also were drilled for additional data gathering. 20 references.

6382 **(SAN—0307-1-Vol.1-3) Solar thermal enhanced oil recovery (STEOR). Final report, October 1, 1979-June 30, 1980.** Elzinga, E.; Arnold, C.; Allen, D.; Garman, R.; Joy, P. (USDOE San Francisco Operations Office, Oakland, CA). Nov 1980. 828p. NTIS.

Thermal enhanced oil recovery is widely used in California to aid in the production of heavy oils. Steam injection, either to stimulate individual wells or to drive oil to the producing wells, is by far the major thermal process today and has been in use for over 20 yr. Since steam generation at the necessary pressures (generally below 4000 kpa (580 psia)) is within the capabilities of present-day solar technology, it is logical to consider the possibilities of solar thermal enhanced oil recovery (STEOR). The present project consisted of an evaluation of STEOR in terms of assessing the technical, economic, and environmental feasibility of using line focusing enhanced oil recovery at Exxon's Edison Field. Also, the potential market for solar equipment which could result if STEOR is used in domestic heavy oil fields was estimated. The merits of a STEOR technology demonstration also were determined. 137 references.

6383 **Fire flood method for recovering petroleum from oil reservoirs of low permeability and temperature.** Kamath, K. (to Dept. of Energy). US Patent 4,465,135. 14 Aug 1984. Filed date 3 May 1983. vp.

PAT-APPL-491133.

The present invention is directed to a method of enhanced oil recovery by fire flooding petroleum reservoirs characterized by a temperature of less than the critical temperature of carbon dioxide, a pore pressure greater than the saturated vapor pressure of carbon dioxide at said temperature (87.7° F. at 1070 psia), and a permeability in the range of about 20 to 100 millidarcies. The in situ combustion of petroleum in the reservoir is provided by injecting into the reservoir a combustion supporting medium consisting essentially of oxygen, ozone, or a combination thereof. The heat of combustion and the products of this combustion which consist essentially of gaseous carbon dioxide and water vapor sufficiently decrease the viscosity of oil adjacent to fire front to form an oil bank which moves through the reservoir towards a recovery well ahead of the fire front. The gaseous carbon dioxide and the water vapor are driven into the reservoir ahead of the fire front by pressure at the injection well. As the gaseous carbon dioxide cools to less than about 88° F. it is converted to liquid which is dissolved in the oil bank for further increasing the mobility thereof. By using essentially pure oxygen, ozone, or a combination thereof as the combustion supporting medium in these reservoirs the permeability requirements of the reservoirs are significantly decreased since the liquid carbon dioxide requires substantially less voidage volume than that required for gaseous combustion products.

6384 **Numerical and physical studies of fluid-driven fracture propagation in jointed rock.** Shaffer, R.J.; Heuze, F.E.; Ingraffea, A.R.; Thorpe, R.K. (Lawrence Livermore National Laboratory, Livermore, CA). *Society of Petroleum Engineers of A.I.M.E. (American Institute of Mining, Metallurgical and Petroleum Engineers), Paper;* **SPE/DOE/GRI 12881**: 471-482(May 1984). (CONF-8405120—).

From SPE/DOE/GRI unconventional gas recovery symposium; Pittsburgh, PA, USA (13 May 1984).

Hydraulic fracturing in rock masses involves complex and coupled processes of fractures propagating in discontinuous media and of fluid flow in discrete channels. The Unconventional Gas Program at Lawrence Livermore National Laboratory is actively developing numerical models to gain insight in the physics of these coupled processes. However powerful and versatile these models are, they must be verified against analytical solutions and/or physical experiments. This paper describes the current status of the FEFFLAP code, which models fluid-driven discrete fracture propagation in jointed media. Results of a preliminary series of physical tests in which hydrofractures were driven across slanted interfaces

between dissimilar materials, in blocks loaded in biaxial compression, are also discussed.

6385 **Pressure behaviour during polymer flow in petroleum reservoirs.** Ikoku, C.U.; Ramey, H.J. Jr. (Petroleum Engineering Dept., The Univ. of Tulsa, Tulsa, OK 74104). *Journal of Energy Resources Technology;* **104**: No. 2, 149-156(Jun 1982).

This paper presents solutions of the nonlinear partial differential equation using the Douglas-Jones predictor-corrector method for the numerical solution of nonlinear partial differential equations. The results are presented in tabular form and as semilogarithmic and log-log type-curve graphs. Graphs of dimensionless pressure versus dimensionless radius also are presented. Compared to results from analytical solutions of the linear partial differential equation, the graphs have the same shape. The error introduced by the linearizing approximation is small for many values of the flow behavior index, /eta/, and decreases as /eta/ tends to unity. Dimensionless pressure is a linear function of dimensionless radius to the power (1 - /eta/), near the well, as predicted by the steady-state equations. Also radius of investigation equation derived analytically agrees with results from numerical solutions.

6386 **Multiple fracturing of boreholes using tailored-pulse loading.** Swift, R.P.; Kusurov, A.S. *Society of Petroleum Engineers of A.I.M.E. (American Institute of Mining, Metallurgical and Petroleum Engineers), Paper;* No. SPE/DOE-9892, 583-593(1981). (CONF-810518—).

From Joint SPE/DOE symposium; Denver, CO, USA (27 May 1981).

A laboratory experiment was developed to study the effects of pressurizing boreholes of rock samples with tailored pulses at intermediate loading rates. The experiment focused on ascertaining the loading conditions needed to initiate multiple fracture growth from a borehole. Experiments were performed under controlled loading conditions with borehole pressures ranging from 10 to 100 mpa, loading rates from one to 100 mpa/msec, and pulse durations of the order from one to 50 msec. The initial conditions of samples were varied to include dry, quasi-dry, and fully saturated states along with pressure confinement of the samples up to 50 mpa. Observations on samples of a medium-porosity sandstone showed that the degree of multiple fracturing is quite sensitive to the condition of the borehole as well as to the loading rate and appears strongly influenced by transient pore-pressure effects.

## 0207 Marketing And Economics

6387 **(DOE/EI/10357—T1) Residential heating oil survey, Pennsylvania, winter 1979-1980. Final report.** Brown, M.; Holst, R.; Hooton, R. (Pennsylvania Governor's Energy Council, Harrisburg (USA)). 20 Jun 1980. Contract FG01-80EI10357. 13p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85002864.

A survey was conducted to obtain information on the supplies and prices of home heating oils in Pennsylvania. One hundred twenty (120) fuel oil dealers were contacted by letter and there were 55 responses - 42 of which were usable. The survey was conducted by phone and 5 pieces of information obtained covering heating oil suppliers, prices and sales. No data are presented. Copies of the questionnaires and letters are included. (DMC)

6388 **(NP—5770084) Mineraloelwirtschaftsverband e.V.: Annual report 1983.** (Mineraloelwirtschaftsverband e.V., Hamburg (Germany, F.R.)). 1983. 49p. (In German). NTIS (US Sales Only), PC A03/MF A01. File Number DE85770084.

The annual report 1983 of the Mineral Oil Economics Federation contains reports about the situation of the mineral oil processing industry, energy politics, mineral oil supply and mineral oil markets 1983. At the end of the reports statistical figures about the mineral oil economics are given.

6389 **(NP—5900314) National stripper well survey.** (Interstate Oil Compact Commission, Oklahoma City, OK (USA)). Oct 1984. 15p. Interstate Oil Compact Comm., Box 53127, Oklahoma City, Oklahoma 73152. File Number TI85900314.

The national stripper well survey published annually provides national and state-by-state data on stripper well operations. Stripper wells are those producing crude oil at a rate of less than ten barrels a dy. This report shows that there were 441,501 stripper wells in operation as of January 1, 1984, and that during the 1983 calendar year 462,013,486 barrels of stripper oil were produced. By comparison, there were 416,493 stripper wells as of January 1, 1983 and during 1982 calendar year they produced 441,951,028 barrels of crude oil. Thus, there was a one-year increase of 25,008 wells and an increase in production of 20,062,458 barrels. For the fourth straight year, the abandonment numbers are up, this time by 17 percent. During 1983, 11,032 stripper wells reached terminal status and became unprofitable to continue operation. These wells each were still capable of producing some oil but not enough to pay the taxes, royalties and operating expenses and leave a sufficient amount of profit for the operator to continue. This is a necessary but regrettable loss to the nation because the oil that might have been captured will never be produced under any conceivable foreseeable circumstance.

6390 **(NP—5900362) International oil companies in the Far East.** Mlotok, P. (Salomon Bros., Inc., New York (USA)). Oct 1984. 12p. Salomon Brothers Inc., Stock Research, One New York Plaza, New York, NY 10004. File Number TI85900362.

All of the major international oil companies have extensive operations in the Far East, and in most cases, these operations account for a significant part of their worldwide earnings. In the refining and marketing end of the business, near-term profitability could be hampered by problems in the Singapore refining center. An expansion of Indonesian refining capacity has reduced profits from processing arrangements, and new Saudi product exports will enter Singapore starting this year. Longer term, however, the strong economic growth in the region renders it a highly attractive area in which to operate. On the producing end, rising output will boost profits for the international oil companies in Indonesia and Malaysia. Caltex (a 50/50 joint venture between Chevron and Texaco) is one of the largest marketers in the Far East. It will not initially be affected greatly by the Singapore refinery problem, as its production from this area goes directly into its own marketing system rather than into the open market. Exxon is a medium-size marketer with especially strong positions in Japan, Malaysia and Thailand. However, the company could be vulnerable to near-term problems in Singapore. Mobil, another medium-size marketer, has a very strong position in Japan but problems in Australia. As those problems are corrected, earnings should grow over time. The Royal Dutch Shell Group is one of the largest marketers in the Far East, with good positions in Singapore, Malaysia and Australia. Shell will have difficulty adjusting to the changing conditions in Singapore, but once this is complete, downstream earnings growth should resume. British Petroleum (BP) has a smaller upstream and downstream presence than the other international oils. Estimated 1983 Far East earnings are tabulated for these five companies. 5 figures.

6391 **(NP—5900364) Refining and marketing in the Far East.** Mlotok, P. (Salomon Bros., Inc., New York (USA)). Oct 1984. 15p. Salomon Brothers Inc., One New York Plaza, New York, NY 10004. File Number TI85900364.

The Far East oil market, while smaller in size than that in Europe or the United States, has been the single most profitable region for the refining and marketing operations of the international oil companies. Oil consumption in the Far East runs about 10 million barrels per day (mmb/d), compared with 16 mmb/d in the United States and 12 mmb/d in Europe. Yet, because of limited competition, above-average efficiency and protective government regulation, the international oil companies have typically earned more than half of their worldwide downstream profits in the Far East. Over the next several years, however, this profitability will be challenged by two emerging trends, and future profits are not likely

to equal those of the past. One of these trends is the growth of refining capacity in the OPEC nations, which will reduce their need to process crude in Singapore refineries and will also increase the volume of product exports entering the Far East. The other trend is the declining use of fuel oil, since natural gas is increasingly used to fire power plants and industry is becoming more efficient in its use of energy. This will present a challenge to the refining industry in the region, since it is not prepared to upgrade the excess fuel oil into lighter products such as gasoline and diesel oil. Among the international oil companies, Shell and Caltex are the dominant factors in the region. Mobile and Exxon have smaller, but highly profitable operations in key markets. British Petroleum (BP) is presemt in most of the former Commonwealth nations. We estimate that in 1983, the four major players earned between $200 and 400 million each, with BP taking a smaller share. The largest single market is Japan, which accounts for half of the consumption in the Far East. 4 figures.

6392 **(OCS/MMS—84-0010) Outer Continental Shelf oil and gas leasing and production program. Annual report, fiscal year 1983.** (Minerals Management Service, Washington, DC (USA)). 30 Mar 1984. 63p. OOIS, M/S 640, Dept. of Interior, Minerals Management Service, Washington, DC 20240. File Number TI85900399.

This report describes the Outer Continental Shelf (OCS) leasing and production activities during FY 1983, including a summary of receipts and expenditures and also includes information on OCS safety violations submitted by the US Coast Guard. Oil and gas production from the OCS constitutes an important part of the nation's domestic energy supply. To provide access to possible new sources of oil and gas offshore, the Department of the Interior (DOI), through the Minerals Management Service (MMS), conducted eight OCS lease sales during FY 1983, one of which was divided into two parts. Tracts in the Gulf of Mexico (GOM) were offered in three of the sales, including the sale that was held in two parts because of special circumstances, involving preparation of the prelease documents. Of the five remaining sales, three were offshore Alaska, and two were in the Mid-Atlantic and south Atlantic. The eight sales resulted in the leasing of 1420 tracts covering 7,493,781 offshore acres. On the basis of MMS figures, oil and gas produced on the OCS in FY 1983 amounted to more than 342 million barrels of crude oil and condensate and more than 4.0 trillion cubic feet of natural gas. Federal offshore oil production amounted to 10.8 percent of total US production during FY 1983, while offshore gas amounted to 24.4 percent of total US production. All of the offshore production occurred in the GOM and off southern California. A total of 383 exploratory wells and 588 development wells was drilled on existing leases during FY 1983. 3 figures, 14 tables.

## 0209 Environmental Aspects

*REFER ALSO TO CITATION(S) 0209007405, 7423*

6393 **(DOE/EA—0098) DOE environmental assessment report.** (Department of Energy, Washington, DC (USA)). Feb 1980. 34p. NTIS.

The US Department of Energy (DOE) has prepared an environmental assessment on the proposed downhole steam generator field test in Kern County, California. Based on these findings DOE has determined that the proposed action does not constitute a major federal action significantly affecting the quality of the human environment within the meaning of the National Environmental Policy Act of 1969 (NEPA). Therefore, an environmental impact statement is not required. The proposed test is part of the DOE enhanced oil recovery program and will test the use of a down-hole steam generator for tertiary recovery of oil rather than conventional surface generated steam injection methods.

## 0210 Legislation And Regulation

6394 **S. 2989: Petroleum Foreign Investment Disclosure Act of 1984. Ninety-Eighth Congress, Second Session.** Washington, DC, USA; Government Printing Office (1984). 12p.

The Petroleum Foreign Investment Disclosure Act of 1984 (S. 2989) establishes reporting requirements on the sale and transfer of oil retail outlets and refineries involving foreign investors. The report must be delivered to DOE within 90 days of the transfer, and must include information on the investor's name, address, nationality, a description of the interest acquired, and the purchase price. The bill specifies other information which the Secretary of DOE may request. It also imposes civil penalties for noncompliance, defines investigative actions to determine ownership, and establishes procedures for DOE to report to Congress.

## 0250 Combustion

*REFER ALSO TO CITATION(S) 0250006352, 7254*

6395 **Fuel droplet vaporization and spray combustion theory.** Sirignano, W.A. (Department of Mechanical Engineering, Carnegie-Mellon University, Pittsburgh, Pennsylvania). *Progress in Energy and Combustion Science;* 9: No. 4, 291-322(1983).

A critical review is presented of modern theoretical developments on problems of droplet vaporization in a high-temperature environment and of spray combustion. Emphasis is placed upon analytical and computational contributions to the theory with some mention of empirical evidence. Four areas of basic phenomena are discussed in some detail: droplet slip and internal circulation, transient heating of the droplets, multicomponent fuel vaporization, and combustion and vaporization of droplet arrays, groups, and sprays. Various relationships amongst these phenomena are analyzed as well. Several other problem areas are given brief mention. Future directions are suggested.

# 03 NATURAL GAS

*REFER ALSO TO CITATION(S) 0300006254*

## 0302 Geology And Exploration

*REFER ALSO TO CITATION(S) 0302006356, 6357*

6396 **(PB—82-220583) Location of drilling sites in Erie County, Pennsylvania by photogeology.** Zielinski, R.E.; McIver, R.D. (Monsanto Research Corp., Miamisburg, OH (USA)). 14 Dec 1981. 72p. (GRI—81-0020). NTIS $9.00.

Researchers used low-altitude (scale: 1:24,000) aerial photography to identify fracture traces in a portion of the Appalachian basin that represent potential natural gas reservoirs in the Eastern gas shales. This study resulted in the location of 220 primary well sites and a comparable number of secondary sites. The results indicate that fracture trace analysis is a suitable final well-siting technique for Devonian shale wells in shallow portions of the Appalachian basin.

6397 **(PB—82-254608) Heat and mass transfer during the growth and dissociation of gas hydrates in porous media.** Holder, G.D.; Angert, P.F. (Pittsburgh Univ., PA (USA)). Apr 1982. 35p. (GRI—80-0140). NTIS $7.50.

An experimental technique for forming cores of propane hydrates converts a compacted zone of ice frost to hydrates by saturation with liquid propane at temperatures slightly above the ice point in order to study phenomena associated with the dissociation of hydrates in the earth. Current studies have found that the heat transfer coefficients between the hydrate and warm water vary from 100 to 4000 kcal/m$^2$-hr-$^0$C. Because these hydrates are a potential source of natural gas, understanding their formation and dissociation into gas and water in media similar to those existing in the earth is needed to develop models for gas production from naturally occurring hydrate zones that exist alone or in association with conventional gas reservoirs.

6398 **Remote characterization of tight gas formations with a NMR logging tool.** Jackson, J.A.; Brown, J.A.; Crawford, T.R. *Society of Petroleum Engineers of A.I.M.E. (American Institute of Mining, Metallurgical and Petroleum Engineers), Paper;* No. SPE/DOE-9860, 313-319(1981). (CONF-810518—).

From Joint SPE/DOE symposium; Denver, CO, USA (27 May 1981).

A new nuclear magnetic resonance logging technique under development at Los Alamos National Laboratory has characteristics which afford several operating and measurement advantages in tight western gas sand formations over existing nuclear magnetic logging tools. Among these are (1) elimination of the need to condition borehole fluids prior to logging a hole, (2) higher sensitivity per unit sample volume, (3) shorter instrumental dead time, and (4) potential for greater formation penetration. The new technique has been laboratory tested in tool geometry. A prototype tool utilizing permanent magnets is under construction and design has started on advanced tools using superconducting magnets.

6399 **Model for the high frequency response of reservoir rocks and its implications on dielectric log interpretation.** Lysne, P. *Society of Petroleum Engineers of A.I.M.E. (American Institute of Mining, Metallurgical and Petroleum Engineers), Paper;* No. SEP/DOE-9862, 327-334(1981). (CONF-810518—).

From Joint SPE/DOE symposium; Denver, CO, USA (27 May 1981).

The electric response of wet reservoir rocks is primarily due to the motion of ions within the pore structure. Electric fields pin some ions at matrix-fluid interfaces, and they contribute to the bulk dielectric properties of the rock. The geometry of the pore structure influences these properties and information concerning it, as well as the water content of the rock, can be inferred from multiple frequency dielectric measurements. Taken together, this information may allow a prediction of the flow properties of the rock. 12 references.

## 0303 Drilling, Production, And Processing

*REFER ALSO TO CITATION(S) 0303006397*

6400 **NMR measurements on western gas sands core.** Brown, J.A.; Jackson, J.A.; Brown, L.F. *Society of Petroleum Engineers of A.I.M.E. (American Institute of Mining, Metallurgical and Petroleum Engineers), Paper;* No. SPE/DOE-9861, 321-326(1981). (CONF-810518—).

From Joint SPE/DOE symposium; Denver, CO, USA (27 May 1981).

Proton longitudinal relaxation measurements have been made on several western gas sands core samples. These water-saturated specimens show a distributed relaxation time reflecting the distribution of pore sizes in the sandstone matrix. Mercury porosimeter determinations of the pore-size distributions correlate well with the nuclear magnetic resonance (NMR) measurements, and in addition show a correlation between bulk porosity and pore size. The NMR signal strength is shown to be related to porosity and water saturation, in all but one case. 15 references.

## 0306 Marketing And Economics

*REFER ALSO TO CITATION(S) 0306006392*

6401 **(DOE/EIA—0130) Natural Gas Monthly, September 1984.** (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). Nov 1984. 130p. NTIS, PC A07/MF A01; 1 - GPO; GPO Dep. File Number DE85003619.

This report presents recent data and current estimates on the consumption, disposition, prices, storage, import and export of natural gas in the USA for September 1984. Also included are operating and financial data for major interstate natural gas pipeline companies plus data on filings, ceiling prices and transportation under the Natural Gas Policy Act of 1978. A feature article on contracts between interstate pipelines and their customers is included. Information on underground storage of natural gas and storage operators is tabulated. Consumption of natural gas during September 1984 was 1161 billion cubic feet (Bcf), 5.1 percent above the September 1983 level. Consumption is broken down into consuming sectors. The average wellhead price in September 1984 was $2.58 per thousand cubic feet (Mcf). In September 1984, the average residential price of natural gas was 6.24 per Mcf slightly above the September 1983 price. 5 figures, 25 tables. (DMC)

## 0308 Environmental Effects

6402 **(PB—82-22778) Boiling and spreading of liquefied natural gas on water.** Dainis, G.A. III; Reid, R.C. (Massachusetts Inst. of Tech., Cambridge (USA)). Feb 1981. 190p. (GRI—82-22778). NTIS $16.50.

Boiling and spreading data obtained experimentally for LNG spills on water agreed fairly well with a postulated model modified to account for a reduction in liquid density because of gas bubbles in the liquid and a heat transfer rate of 25 kW/m$^2$. Initial spreading rates were about 165 ft (50 m)/s and dropped to zero as the spill reached the final spreading distance. The spreading and vaporization data are believed to be the first obtained under carefully controlled conditions and could prove useful in testing the accuracy of current LNG-spill models.

## 0309 Artificial Stimulation

*REFER ALSO TO CITATION(S) 0309006372, 6384, 7553*

6403 **(DOE/FE—0017) Tight gas research and development: the industry perspective.** Brashear, J.P.; Elkins, L.E.; Haas, M.R. (Department of Energy, Washington, DC (USA)). Feb 1982. 40p. NTIS.

Low permeability gas reservoirs (tight gas sands) are abundant in the US. Economic recovery of the gas in these formations requires reservoir stimulation, usually massive hydraulic fracturing. Significant investigations of tight gas sands by the National Petroleum Council, Lewin and Associates, and the Gas Research Institute have agreed that, although some formations can be profitably produced with existing technology, improved reservoir diagnostic and stimulation techniques are required to realize the full potential of the resource. Most major operators and well-service companies conduct research and development to improve tight gas technology. A survey of tight gas research managers in 8 companies was conducted to determine their research and development priorities and the constraints under which they operate.

6404 **Hydraulic fracture propagation in layered rock: experimental studies of fracture containment.** Teufel, L.W.; Clark, J.A. *Society of Petroleum Engineers of A.I.M.E. (American Institute of Mining, Metallurgical and Petroleum Engineers), Paper;* No. SPE/DOE-9878, 449-456(1981). (CONF-810518—).

From Joint SPE/DOE symposium; Denver, CO, USA (27 May 1981).

Fracture geometry is an important concern in the design of a massive hydraulic fracture treatment for improved natural gas recovery from tight gas sands. Possible prediction of vertical fracture growth and containment in layered rock requires an improved understanding of the parameters which may control fracture growth across layer interfaces. Laboratory hydraulic fracture experiments and elastic finite element studies have been conducted which show that at least 2 distinct geologic conditions may inhibit or contain the vertical growth of hydraulic fractures in layered rock: (1) a weak interfacial shear strength of the layers, and (2) a compressional increase in the minimum horizontal stress in the bounding layer. The second condition is more important and more likely to occur at depth. Variations in the horizontal stress can result from differences in elastic properties of individual layers in a layered rock sequence. A compressional increase in the minimum horizontal stress can occur in going from high shear modulus into low shear modulus layers.

### 0320 Transport, Pipelines, And Handling

6405 **(PB—82-254582) Critical analysis of condition-survey techniques for gas distribution systems.** Johnson, D.; Huebler, J.E.; Craig, J.M.; Landahl, C. (Institute of Gas Technology, Chicago, IL (USA)). Feb 1981. 309p. (GRI—79-0087). NTIS $24.00.

Comparing the US gas distribution system's physical characteristics, failure modes, and operating conditions, IGT engineers identified six promising nondestructive testing methods for determining the condition of in-place piping systems: (1) magnetic field/eddy current; (2) ultrasonic; (3) backscatter radiation; (4) acoustic leak detection; (5) acoustic emission analysis; and (6) vibrational analysis. By supplementing NDT data with statistical and analytical techniques, utilities can quantify current pipe conditions and predict the probability of failure. A subjective economic analysis indicated no distinct cost advantage among the six techniques.

6406 **(PB—82-254632) Basic research and macromolecular dynamics.** Weiner, J.H. (Brown Univ., Providence, RI (USA)). Jun 1982. 17p. (GRI—81-0072). NTIS $6.00.

Because plastic pipe is widely used for natural gas distribution lines, a thorough understanding of the mechanical behavior of plastics is needed to maximize safety and economy. The Gas Research Institute sponsored this study to develop computer simulation techniques that can be used to interpret and predict the macroscopic behavior of polymeric solids on the atomic level, treating individual long-chain molecules. Working on several different problem areas, investigators concluded that (1) long-chain molecules in solution or above the glass transition temperature in amorphous regions of polymeric solids posses a high degree of mobility because of possible rotation about backbone bonds over low rotational energy barriers, (2) theoretical questions remain as to the appropriate mathematical description of the strong covalent bonds of the backbone of a long-chain molecule, and (3) a new approach developed for calculating the elastic moduli in crystals deals directly in terms of electron density distribution instead of empirical interatomic potentials. Future efforts will develop the computer simulation for use in designing polymers with the desired properties.

### 0330 Properties

6407 **(PB—82-254624) Measurement of in situ hydrate thermodynamic properties.** Sloan, E.D. (Colorado School of Mines, Golden (USA)). Mar 1982. 20p. (GRI—80-0155). NTIS $6.00.

Heat capacities and heats of fusion measured in simulated in situ natural gas hydrates using tetrahydrofuran hydrates in clean sand indicated that sediments significantly affect hydrate formation conditions. These data are required to devise and evaluate methods for producing natural gas from hydrates, a potentially significant energy resource.

### 0340 Combustion

*REFER ALSO TO CITATION(S) 0340006395, 7254*

## 04 OIL SHALES AND TAR SANDS

### 0401 Reserves And Exploration

6408 (DOE/METC/SP—80-23, pp 3-29) **Possible interaction between thin-skined and basement tectonics in the Appalachian basin and its bearing on exploration for fractured shale.** Dean, C.S.; Overbey, W.K. Jr. Oct 1980. NTIS.

In US Department of Energy Morgantown Energy Technology Center report.

The Devonian shale of the Appalachian basin is an enormous, virtually untappred resource of natural gas. Production rates are low; even better wells are marginally economic. Most of the gas produced arrives at the well bore via natural fractures; the direct contribution from the shale matrix, where most of the gas is held, is minimal. Hence, exploration for highly-fractured areas within the shale is a most important aspect of the Department of Energy's eastern gas shales program. Fracture permeability is primarily the net result of jointing that occurred following stress (Sigma 3) by the tensile strength (K) of the rock, provided Sigma 1 - Sigma 3 $<$ 4 K. Consequently, the formation of joints, which show evidence of being tension fractures, is not depth restricted. Carbonate mineralization of many natural fractures seen in Devonian shale core testifies to the role of fluids. 24 references.

### 0402 Site Geology And Hydrology

*REFER ALSO TO CITATION(S) 0402006336, 6408*

6409 (DOE/METC/SP—80-23, pp 56-63) **Fracture patterns across the Burning Springs anticline in West Virginia preliminary investigation.** Werner, E. Oct 1980. NTIS.

In US Department of Energy Morgantown Energy Technology Center report.

Fracture patterns derived from outcrop measurements and photolineament patterns derived from mapping a landsat image in the area of the Burning Springs anticline were studied. Results indicate some differences between patterns to the east and patterns to the west of the anticlinal axis implying some differences in the stresses active on opposite sides of the anticline.

6410 (DOE/METC/SP—80-23, pp 34-40) **Western limit of extension fracturing in West Virginia.** Berger, P.S.; Wheeler, R.L. Oct 1980. NTIS.

In US Department of Energy Morgantown Energy Technology Center report.

Extension fractures can extend beds and create porosity, permeability, or both where dips on anticlinal limbs are relatively steep (greater than 45 if there is no strain parallel to hinge lines). Simple calculations and reasonable assumptions permit the conclusion that including the effect of hinge line parallel strain does not alter significantly the minimum bed dip at which extension fractures will open. Therefore, the minimum conditions necessary for extension fracture formation are unlikely to occur west of Gwinn's high plateau, with the exception of the Burning Springs anticline, in Wood and Wirt Counties, West Virginia, where limb dips reach a maximum of 68.

### 0404 Oil Production, Recovery, And Refining

6411 (DOE/ET/2628—1, pp 63-72) **Enhanced oil recovery from heavy oil reservoirs. Mining for heavy oil.** Hutchins, J.S. Jul 1980. NTIS.

In US Department of Energy Fossil Energy report.

Two methods of oil mining are discussed. The first method is the use of a stabilization bed of hot water on top of a shallow reservoir. Steam injected below the bed would change the viscosity and the oil would rise through the stabilization bed. The second method is shaft and tunnel mining. A shaft would be placed down through or around a reservoir until it was underneath it. Horizontal tunnels would be drilled out below the reservoir in very close proximity to it. Short wells would be drilled upward, in a high density pattern, and oil would be produced by gravity drainage. The following reasons are presented as to why the mining option is preferable to using vertical wells from the surface: capital costs, operating costs, rate of production, economic limit, ultimate recovery, price sensitivity, and rate of return.

6412 **(DOE/TIC/EG—80/29) In situ retorting of oil shale. Method to extract oil thermally from underground shale formations is proposed.** (USDOE Office of Scientific and Technical Information, Oak Ridge, TN). 1980. 2p. (PB—80-979111). NTIS.

A method for extracting oil from shale in situ is described. Shafts would be sunk in oil shale deposits 315-ft (95-m) thick that lie 1300 ft (390 m) below ground level in Colorado, and a mine would be developed on 5 levels. When enough excess material had been removed, vertical chambers of crushed shale 150-ft (45-m) wide, 405-ft (122-m) long, and 312-ft (94-m) high would be produced with explosives. The column of fractured shale would be en-

closed, its top surface ignited, and air and steam sucked down through the column. The fire would decompose the shale kerogen into oil, gas, and residual carbon. Oil, gas, and water produced by the in situ retorting would be collected at the bottom level of the mine.

6413 **Overview of LASL oil shale program.** Morris, W. *American Association of Petroleum Geologists, Bulletin;* 65: No. 5, 961(May 1981).

The Los Alamos Scientific Laboratory (LASL) is involved in a broad spectrum of oil shale-related activities for the US Department of Energy (DOE), including the bed preparation design of a modified in situ retort. This aspect of oil shale research has been identified by DOE as one of the limiting technologies impeding commerical, in situ development of oil shale. The retort bed must have uniform particle size, permeability, and void distributions to allow proper retorting and optimum resource recovery. Controlled fracturing using chemical explosives and carefully designed blasting schemes are the only feasible methods to attain this distribution. This approach to the bed preparation problem is a coordinated research program of explosives characterization, dynamic rock mechanics, predictive computer modeling, and field verification tests. The program is designed to develop the predictive fracturing capability required for the optimum rubbing of the shale.

# 05 NUCLEAR FUELS

## 0501 Reserves

*REFER ALSO TO CITATION(S) 0501008065*

6414 **(DOE/S—0028) United States uranium mining and milling industry: a comprehensive review.** (USDOE Energy Information Administration, Washington, DC). May 1984. 109p. NTIS, PC A06/MF A01; GPO Dep. File Number DE85000696.

Report to the Congress by the President of the United States.

This report presents information on the current and projected status of the domestic uranium mining and milling industry including uranium requirements and inventories, domestic production, import penetration, domestic and foreign ore reserves, exploration expenditures, employment, and capital investment. In addition to presenting projections of industry behavior under current policy, the report provides projections under alternative policy scenarios in the event that foreign import restrictions were enacted by Congress. The anticipated effect of spent nuclear fuel reprocessing on the demand for uranium is also addressed. 18 figures, 21 tables.

6415 (GSO—1981-0065, pp vp) **Results of ground follow-up. Pt. B.** Cole, D.I. Apr 1981. Geological Survey, Private Bag X112, Pretoria, 0001, South Africa.

Open file 240.

In Karoo airborne geophysical survey: preliminary report on some radiometric anomalies in block 6.

Results of the ground follow-up of eleven radiometric anomalies of the Karoo airborne geophysical survey in block 6 are described. Ten of these anomalies are caused by uranium mineralisation in the basal parts of fluvial channel sandstones of the Beaufort Group, whereas the remaining anomaly is due to uranium mineralisation in the basal part of a delta plain channel sandstone of the Waterford Formation. The source concentrations vary between 100 ppm and 19 900 ppm $eU_3O_8$ and the areal extent of the mineralisation varies from 1200 square metres to 15 000 square metres. However, the mineralisation tends to be sporadic. The thickness of the mineralised sandstones vary between 0,65 m and 3,7 m. Subsurface mineralisation, which normally occurs along the palaeochannel within the sandstone, is possible in the immediate vicinity of 6 of the anomalies. Further investigations are recommended for the 4 areas.

6416 (GSO—1981-0065, pp vp) **Airborne radiometric data. Pt. A.** Stettler, E.H. Apr 1981. Geological Survey, Private Bag X112, Pretoria, 0001, South Africa.

Includes maps.

In Karoo airborne geophysical survey: preliminary report on some radiometric anomalies in block 6.

Some radiometric anomalies selected from the radiometric data of block 6 (Karoo airborne geophysical survey) are presented and discussed from a geophysical point of view.

6417 (GSO—1981-0067, pp vp) **Karoo airborne geophysical survey: preliminary report on radiometric anomalies selected from the analogue data of block 13. Pt. B. Results of ground follow-up.** Cole, D.I. 1981. Geological Survey, Private Bag X112, Pretoria, 0001, South Africa.

Open file 239.

In Karoo airborne geophysical survey: preliminary report on radiometric anomalies from block 13.

Results of the ground follow-up of eight radiometric anomalies of the Karoo airborne geophysical survey in block 13 are described. No significant uranium mineralisation was detected and the anomalies can all be classed as superficial.

## 0502 Exploration

*REFER ALSO TO CITATION(S) 0502006415, 6417*

6418 **(GSO—1981-0065) Karoo airborne geophysical survey: preliminary report on some radiometric anomalies in block 6.** (Department of Mineral and Energy Affairs, Pretoria (South Africa). Geological Survey). Apr 1981. vp. Geological Survey, Private Bag X112, Pretoria, 0001, South Africa.

Individual sections were processed for inclusion in the Energy Data Base.

6419 (GSO—1981-0067, pp vp) **Karoo airborne geophysical survey: preliminary report on radiometric anomalies selected from the analogue data of block 13: Pt. A. Airborne radiometric data.** Stettler, E.H. 1981. Geological Survey, Private Bag X112, Pretoria, 0001, South Africa.

Includes maps.

In Karoo airborne geophysical survey: preliminary report on radiometric anomalies from block 13.

Eight radiometric anomalies selected from the airborne radiometric data of block 13 are discussed. All eight anomalies were graded as of very low interest. The report describes the uranium anomalies which were identified from the analogue spectrometer records of block 13.

6420 **(GSO—1981-0067) Karoo airborne geophysical survey: preliminary report on radiometric anomalies from block 13.** Stettler, E.H.; Cole, D.I. (Department of Mineral and Energy Affairs, Pretoria (South Africa). Geological Survey). 1981. vp. Geological Survey, Private Bag X112, Pretoria, 0001, South Africa.

Individual sections of this report were processed for inclusion in the Energy Data Base.

6421 (GSO—1982-0222, pp vp) **Results of ground follow-up. Pt. 2.** Stettler, E.H.; Labuschagne, L.S. 1982. Geological Survey, Private Bag X112, Pretoria, 0001, South Africa.

Open file 263.

In Karoo airborne geophysical survey: report on aerial radiometric anomalies of block 7.

The results of the ground follow-up of aerial radiometric anomalies are described. Although radiometric anomalies, as selected from the analogue spectrometer records, occur throughout the whole block, only four have limited significance, and these occur within the Adelaide Subgroup of the Beaufort Group.

6422 (GSO—1982-0222, pp vp) **Airborne radiometric data. Pt. 1.** Stettler, E.H.; Labuschagne, L.S. 1982. Geological Survey, Private Bag X112, Pretoria, 0001, South Africa.

Open file 263.

In Karoo airborne geophysical survey: report on aerial radiometric anomalies of block 7.

Sixteen uranium anomalies were selected from the analogue spectrometer records of block 7 of the Karoo Airborne Geophysical Survey. Of these four proved to be of significance in the follow-up investigations and they are shown on the accompanying 1:250 000 scale map. The positions and farms on which they occur are tabulated.

6423 **(GSO—1982-0222) Karoo airborne geophysical survey: report on aerial radiometric anomalies of block 7.** (Department of Mineral and Energy Affairs, Pretoria (South Africa). Geological Survey). 1982. vp. Geological Survey, Private Bag X112, Pretoria, 0001, South Africa.

Individual sections were processed for inclusion in the Energy Data Base.

## 0503 Mining

*REFER ALSO TO CITATION(S) 0503006414, 6462, 6528*

## 0504 Feed Processing

*REFER ALSO TO CITATION(S) 0504006414, 6530*

6424 (INIS-mf—9098, pp 101-103) **Lodeve mill: a complex alkaline process for a complex uranium ore.** Bodu, R.; Herbert, J.P.; Lafforgue, P.; Lyaudet, G. (COGEMA, France); Michel, P.; Vanhelleputte, R. (SIMO, 75 - Paris (France)). 1984. NTIS (US Sales Only), PC A08/MF A01. File Number TI85780156. (CONF-8403156—Absts.).

From MINTEK 50: international conference on recent advances in mineral science and technology; Sandton, South Africa (26 Mar 1984).

6425 (INIS-mf—9098, pp 97-98) **Novel application of resin-in-pulp in the metallurgical industry.** Fleming, C.A.; Cromberge, G. (Council for Mineral Technology, Randburg (South Africa)). 1984. NTIS (US Sales Only), PC A08/MF A01. File Number TI85780156. (CONF-8403156—Absts.).

From MINTEK 50: international conference on recent advances in mineral science and technology; Sandton, South Africa (26 Mar 1984).

6426 (INIS-mf—9098, pp 77-78) **Modelling of the Hartebeestfontein gold mine uranium leaching and ion exchange processes and its role in economic plant operation.** Broekman, B.R.; Ward, B. (Hartebeestfontein Gold Mining Co. Ltd., South Africa). 1984. NTIS (US Sales Only), PC A08/MF A01. File Number TI85780156. (CONF-8403156—Absts.).

From MINTEK 50: international conference on recent advances in mineral science and technology; Sandton, South Africa (26 Mar 1984).

6427 (INIS-mf—9098, pp 74-75) **Uranium-bearing minerals in Witwatersrand rocks, and their behaviour during leaching.** Smits, G. (Council for Mineral Technology, Randburg (South Africa)). 1984. NTIS (US Sales Only), PC A08/MF A01. File Number TI85780156. (CONF-8403156—Absts.).

From MINTEK 50: international conference on recent advances in mineral science and technology; Sandton, South Africa (26 Mar 1984).

6428 (INIS-mf—9098, pp 36-37) **Role of waste sorting in the South African gold mining industry.** Freer, J.S.; Boehme, R.C. (General Mining Union Corp. Ltd., Johannesburg (South Africa)). 1984. NTIS (US Sales Only), PC A08/MF A01. File Number TI85780156. (CONF-8403156—Absts.).

From MINTEK 50: international conference on recent advances in mineral science and technology; Sandton, South Africa (26 Mar 1984).

6429 **(NLCO—2022) General overview of FMPC operations.** Adams, W.J. (NLO, Inc., Cincinnati, OH (USA)). 1 Oct 1984. Contract AC05-76OR01156. 10p. (CONF-8410166—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85002193.

From Plutonium/uranium recovery operations conference; Oak Ridge, TN, USA (16 Oct 1984).

NLO, Inc. (NLO) has been the contract operator of the Feed Materials Production Center (FMPC) for the DOE and its predecessor agencies since construction and limited production were begun in 1951. A wide variety of chemical and metallurgical process steps are utilized at the FMPC for the conversion of $UF_6$ and enriched uranium recycle materials to machined uranium ingots and billets for fabricating uranium metal products. These FMPC products are used in defense programs of the Department of Energy. Major emphasis is currently being given to production activity for satisfying programmatic requirements related to the operation of government-owned, contractor-operated nuclear production reactors located at Richland, Washington and Savannah River, South Carolina.

## 0505 Enrichment

6430 **(KFK—3689) Report on the results of research and development work in 1983 of the Institut fuer Kernverfahrenstechnik.** (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Kernverfahrenstechnik). Feb 1984. 10p. (In German). NTIS (US Sales Only), PC A02/MF A01. File Number DE84752300.

In this report a survey is presented of the continuing work of the Institute for Nuclear Processing Technology. The research relates primarily to the development and testing of the separation nozzle process for uranium isotope separation. Further subjects are the production and acceleration of negative H-ions (for fusion experiments) and investigations to elucidate the properties of helium clusters.

6431 **(SAND—84-2092C) Centrifuge tests to provide closure bounds for switches subjected to random vibration.** Rodeman, R.; Priddy, T.G. (Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 18p. (CONF-850118—3-Draft). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85002003.

From 3. international modal analysis conference; Orlando, FL, USA (28 Jan 1985).

A centrifuge test at a constant acceleration level that bounds from above the closure that would be experienced by a normally open switch subjected to a stationary random excitation of fixed duration is derived. The bound is probabilistic in that the induced displacement will be exceeded with a certain selectable probability. The bound was formulated in terms of the system modal properties. Because the spatial distribution of the excitation is smooth and the frequency content is wide band the response is dominated by the first few lowest modes of the structure. It is further shown that the bound is relatively insensitive to the selected desired reliability. Experiments which verify the validity of the bound have been performed.

6432 **(UCID—20160) AVLIS industrial access program.** (Lawrence Livermore National Lab., CA (USA); Martin Marietta Energy Systems, Oak Ridge, TN (USA)). 15 Nov 1984. Contract W-7405-ENG-48;AC05-84OR21400. 112p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE85002957.

This document deals with the procurements planned for the construction of an Atomic Vapor Laser Isotope Separation (AVLIS) production plant. Several large-scale AVLIS facilities have already been built and tested; a full-scale engineering demonstration facility is currently under construction. The experience gained from these projects provides the procurement basis for the production plant construction and operation. In this document, the status of the AVLIS process procurement is presented from two viewpoints. The AVLIS Production Plant Work Breakdown Structure is referenced at the level of the items to be procured. The availability of suppliers for the items at this level is discussed. In

addition, the work that will result from the AVLIS enrichment plant project is broken down by general procurement categories (construction, mechanical equipment, etc.) and the current AVLIS suppliers are listed according to these categories. A large number of companies in all categories are currently providing AVLIS equipment for the Full-Scale Demonstration Facility in Livermore, California. These companies form an existing and expanding supplier network for the AVLIS program. Finally, this document examines the relationship between the AVLIS construction project/operational facility and established commercial suppliers. The goal is to utilize existing industrial capability to meet the needs of the project in a competitive procurement situation. As a result, costs and procurement risks are both reduced because the products provided come from within the AVLIS suppliers' experience base. At the same time, suppliers can benefit by the potential to participate in AVLIS technology spin-off markets. 35 figures.

6433 **(UCID—20180) AVLIS documentation overview and tables of contents.** (Lawrence Livermore National Lab., CA (USA); Martin Marietta Energy Systems, Oak Ridge, TN (USA)). 15 Nov 1984. Contract W-7405-ENG-48;AC05-84OR21400. 138p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE85002959.

Three documents constitute the executive summary series in Data Package III: this document (Documentation Overview and Tables of Contents (E001)) plus the AVLIS Production Plant Executive Summary (E010) and the AVLIS Production Plant Overall Design Report (E020). They provide progressively greater detail on the key information and conclusions contained within the data package. The Executive Summary and Overall Design Report present summaries of each Data Package III document. They are intended to provide a global overview of AVLIS Production Plant deployment including program planning, project management, schedules, engineering design, production, operations, capital cost, and operating cost. The purpose of Overview and Tables of Contents is threefold: to briefly review AVLIS goals for Data Package III documentation, to present an overview of the contents of the data package, and to provide a useful guide to information contained in the numerous documents comprising the package.

6434 **(UCID—20190) AVLIS Production Plant work breakdown structure and Dictionary.** (Lawrence Livermore National Lab., CA (USA); Martin Marietta Energy Systems, Oak Ridge, TN (USA)). 15 Nov 1984. Contract W-7405-ENG-48;AC05-84OR21400. 117p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE85002961.

The work breakdown structure has been prepared for the AVLIS Production Plant to define, organize, and identify the work efforts and is summarized in Fig. 1-1 for the top three project levels. The work breakdown structure itself is intended to be the primary organizational tool of the AVLIS Production Plant and is consistent with the overall AVLIS Program Work Breakdown Structure. It is designed to provide a framework for definition and accounting of all of the elements that are required for the eventual design, procurement, and construction of the AVLIS Production Plant. During the present phase of the AVLIS Project, the conceptual engineering phase, the work breakdown structure is intended to be the master structure and project organizer of documents, designs, and cost estimates. As the master project organizer, the key role of the work breakdown structure is to provide the mechanism for developing completeness in AVLIS cost estimates and design development of all hardware and systems. The work breakdown structure provides the framework for tracking, on a one-to-one basis, the component design criteria, systems requirements, design concepts, design drawings, performance projections, and conceptual cost estimates. It also serves as a vehicle for contract reporting. 12 figures, 2 tables.

6435 **(UCID—20191) AVLIS production plant project schedule and milestones.** (Lawrence Livermore National Lab., CA (USA); Martin Marietta Energy Systems, Oak Ridge, TN (USA)). 15 Nov 1984. Contract W-7405-ENG-48;AC05-84OR21400. 142p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE85002960.

An AVLIS Production Plant Deployment Schedule for the engineering, procurement, and construction for both the Initial Increment of Production and the fully Activated Plant, has been developed by the project team consisting of Lawrence Livermore National Laboratory, Martin Marietta Energy Systems, Inc. with architect-engineer support from Bechtel National, Inc., Stone and Webster Engineering Corporation, and Westinghouse Corporation. The initial deployment phase consists of six separators modules and the three laser power amplifier modules consistent with the FY84 reference design with a name plate capacity of 5 million separative work units/yr followed by a full plant activation to approximately 13 million separative work units/yr. The AVLIS Production Plant project team's strategy for deployment schedule analysis focused on three schedule options: engineering limited schedule; authorization limited schedule; and funding limited project schedule. The three deployment schedule options developed by AVLIS project team have been classified in ranges such as an optimistic, rapid/moderate, or moderate/pessimistic based on the probability of meeting the individual schedule option's major milestones or program objectives of enriching uranium by the AVLIS process in an effective cost and schedule manner. 47 figures, 7 tables.

6436 **(UCID—20197) AVLIS production plant waste management plan.** (Lawrence Livermore National Lab., CA (USA); Martin Marietta Energy Systems, Oak Ridge, TN (USA)). 15 Nov 1984. Contract AC05-84OR21400;W-7405-ENG-48. 114p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE85002956.

Following the executive summary, this document contains the following: (1) waste management facilities design objectives; (2) AVLIS production plant wastes; (3) waste management design criteria; (4) waste management plan description; and (5) waste management plan implementation. 17 figures, 18 tables.

6437 **(UVA-ER—961-84U) User's guide to LROTOR: a three-dimensional stability analysis computer code.** Hendricks, S.L.; Wayland, R.L. III; Wood, H.G. III. (Virginia Univ., Charlottesville (USA). School of Engineering and Applied Science). Oct 1984. Contract AC05-82OR20900. 91p. NTIS, PC A05. File Number DE85003343.

This document is designed to provide the user with a brief guide as to the use of the three-dimensional stability analysis computer code known as LROTOR.

6438 **The competitive enrichment market.** Parks, J.W.; Huffman, F.C. (U.S. Department of Energy, Oak Ridge, TN). pp 12 of Shaping our energy future. Knoxville, TN, USA; LTM Consultants (1984). (CONF-840229—).

From 11. annual WATTec conference and exposition - shaping our energy future; Knoxville, TN, USA (21 Feb 1984).

Abstract only.

With the enactment of the "Private Ownership of Special Nuclear Materials Act" in 1964, the U.S. Government made provisions to enter into the uranium enrichment services business. Since nuclear power was in its infancy and the Government was promoting its growth as well as trying to help U.S. industry sell reactors overseas, the initial contracts (Requirements Contracts) for enrichment services placed most of the risks associated with the supplying of the services on the Government. Projections of nuclear power additions continued to grow and in 1972 the Atomic Energy Commission (AEC) stopped contracting under Requirements Contracts in order to study which mode of contracting best suited the commercial development of the industry. In mid-1973, the AEC introduced the Long-Term Fixed Commitment (LTFC) contract which shifted the risk to the customer. By mid-1974, AEC had contracts which completely used the enrichment capacity of its complex and refused to accept requests for additional contracts. This action further convinced European nations that they should continue to develop their own enrichment capacity and resulted in the EURODIF and URENCO projects. Before this time the U.S. supplied 100% of the world market for enriching services.

6439 **Gaseous diffusion -- the enrichment workhorse.** Shoemaker, J.E, Jr. (Union Carbide Corp., Oak Ridge, TN). pp 10-11 of Shaping our energy future. Knoxville, TN, USA; LTM Consultants (1984). (CONF-840229—).

From 11. annual WATTec conference and exposition - shaping our energy future; Knoxville, TN, USA (21 Feb 1984).

Abstract only.

Construction of the first large-scale gaseous diffusion facility was started as part of the Manhattan Project in Oak Ridge, Tennessee, in 1943. This facility, code named "K-25," began operation in January 1945 and was fully on stream by September 1945. Four additional process buildings were later added in Oak Ridge as the demand for enriched uranium escalated. New gaseous diffusion plants were constructed at Paducah, Kentucky, and Portsmouth, Ohio, during this period. The three gaseous diffusion plants were the "workhorses" which provided the entire enriched uranium demand for the United States during the 1950s and 1960s. As the demand for enriched uranium for military purposes decreased during the early 1960s, power to the diffusion plants was curtailed to reduce production. During the 1960s, as plans for the nuclear power industry were formulated, the role of the diffusion plants gradually changed from providing highly-enriched uranium for the military to providing low-enriched uranium for power reactors.

6440 **The Advanced Gas Centrifuge program.** Riepe, R. (Union Carbide Corp., Oak Ridge, TN). pp 11 of Shaping our energy future. Knoxville, TN, USA; LTM Consultants (1984). (CONF-840229—).

From 11. annual WATTec conference and exposition - shaping our energy future; Knoxville, TN, USA (21 Feb 1984).

Abstract only.

Although the gas centrifuge process for uranium enrichment is often referred to as a "new technology," it has been under development for approximately 25 years to bring it to its current state of deployment. Centrifuges are now being installed in a new gas centrifuge enrichment plant (GCEP) at Portsmouth, Ohio. The objective of this new plant was to provide additional U.S. uranium enrichment capacity at a production cost comparable to the U.S. diffusion process but requiring much less power per separative work unit (SWU) produced. The current, commercial scale centrifuge technology being installed meets that objective. The objective for new U.S. enrichment capacity has changed. The objective is not to provide more SWUs but to provide cheaper SWUs. The objective is to make the U.S. uranium enrichment enterprise competitive on the international market. Where the U.S. at one time supplied virtually all of the free world SWU demand, the U.S. market share has now dropped to approximately 35% of the foreign free world market. The Advanced Gas Centrifuge (AGC) program provides an avenue for making the U.S. the economically attractive, reliable enrichment supplier.

6441 **Atomic Vapor Laser Isotope Separation program.** Husley, W.J. (Union Carbide Corp., Oak Ridge, TN). pp 11 of Shaping our energy future. Knoxville, TN, USA; LTM Consultants (1984). (CONF-840229—).

From 11. annual WATTec conference and exposition - shaping our energy future; Knoxville, TN, USA (21 Feb 1984).

Abstract only.

The AVLIS process is based on selective photoionization of the $U^{235}$ isotope in an atomic vapor stream. The specifically tuned light is generated in dye lasers coherently pumped with copper vapor lasers. The resulting $U^{235}$ ions are electrostatically removed from the vapor stream and condensed as a liquid on hot product collectors. The tails stream is also processed as liquid metal and continually removed from the process chamber. The basic science and technology for AVLIS have been demonstrated over the past 10 years in a variety of component and subscale integrated test systems. The program is now constructing and starting up several near full-scale demonstration facilities which are described. The motivation for AVLIS is in its inherently lower production costs and, thus, its impact on the U.S. position in the enrichment market. To assure the earliest deployment of the technology, conceptual design for a production facility is underway with a goal of low-cost SWU production in the early 1990s.

## 0507 Fuels Production And Properties

*REFER ALSO TO CITATION(S) 0507007148, 7243*

## 0508 Spent Fuels Reprocessing

*REFER ALSO TO CITATION(S) 0508006458, 6474, 6482*

6442 **(ETR—318) Proceedings of the seminar on Eurochemic experience at Mol (Belgium), June 9-11, 1983.** Drent, W.; Delande, E. (eds.). (European Company for the Chemical Processing of Irradiated Fuels, Mol (Belgium)). 1984. 244p. (In French). (CONF-8306235—). NTIS (US Sales Only), PC A11/MF A01. File Number DE85780073.

From Eurochemic experience; Mol, Belgium (9 Jun 1983).

Individual papers were processed for inclusion in the Energy Data Base.

6443 **(INIS-mf—9088) Attainments in reprocessing and storage of fission wastes.** (Koninklijk Inst. van Ingenieurs, The Hague (Netherlands)). 29 Sep 1981. 150p. (In Dutch). (CONF-8109267—). NTIS (US Sales Only), PC A07/MF A01. File Number DE85780140.

From Attainments in reprocessing and storage of fission wastes conference; Petten, Netherlands (29 Sep 1981).

Individual papers were processed for inclusion in the Energy Data Base.

6444 **(INIS-mf—9100) Sellafield.** (British Nuclear Fuels Ltd., Sellafield). 1984. 21p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85780158.

This small, illustrated, booklet describes Sellafield under the headings: introduction (historical and general); organisation (Windscale Works; Calder Works); Magnox reprocessing (using nuclear fuel in a reactor; transport of fuel; used fuel stored in ponds; decanning of Magnox fuel; separation process; highly-active storage tanks; vitrification); waste disposal; health and safety; Calder Hall; future developments; training young people; community relations.

6445 **(Juel-Spez—247) Research for the safety of the nuclear fuel cycle.** Nickel, H.; Linke, J.; Viefers, W. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorwerkstoffe und Heisse Zellen). Mar 1984. 32p. (In German). NTIS (US Sales Only), PC A03/MF A01. File Number DE84752290.

In the Federal Republic of Germany, different stages have been reached in the development of methods for the production and for the disposal of nuclear fuel elements: From a safety engineering point of view, further research and development of production methods is no longer necessary. With regard to the disposal end of the fuel cycle ("Entsorgung"), the feasibility of interim storage and reprocessing has been a prerequisite for the operation approval of nuclear plant. The licensing approval is currently based on dry storage of irradiated fuel in transport casks (Gorleben, Ahaus); reprocessing contracts with foreign facilities (COGEMA, BNFL); reprocessing in a national facility (WA-350); final storage in deep geological formations (Gorleben, Konrad). Numerous research and development activities on nuclear fuel disposal have been started in recent years; most of these programmes now have been sucessfully completed. The few continuing programmes are concerned with safety engineering and comprise the minimization of the amount of waste, the recycling of plutonium, waste product quality, reduction of radiation exposure, and long-term final storage with and without reprocessing. From the available results, it can be deduced that as regards safety engineering there can be no objection to closing the light water reactor fuel cycle.

6446 **(KFK—3634) Performance of coalescence and wetting on the operating characteristics of pulsed plate columns.** Schmidt, H.; Eggert, E.; Lessle, E.M. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorbauelemente; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Wiederaufarbeitung und Abfallbehandlung). May 1984. 48p. (In German). (PWA—27/84). NTIS (US Sales Only), PC A03/MF A01. File Number DE84752332.

The fluid dynamic behavior of pulsed plate columns is influenced by the inner parameters of the extraction system while the outer parameters are kept constant. There are two reasons for the change in operating characteristics with time: change in coalescence behavior of the system, change in wetting behavior of the cartridge. There is a strong influence on the dispersed phase holdup in both cases, causing the regime of operation to be discontinued (relinquished) and leading in a situation which requires the through put to be diminished and finally to be stopped. The effect of coalescence is characterized by measurement of coalescence time, the effect of wetting by contact angle measurement. Steps (expedients) in design are proposed to act against retardation in drop-drop coalescence. The required good wettability of column cartridge by the continuous phase is achieved by direct application of a supersonic cleaning method which guaranties the fluid dynamic stable mode of operation in practice.

6447 **(ORNL/TM—9297) Consolidated Fuel Reprocessing Program. Progress report, April 1-June 30, 1984.** (Oak Ridge National Lab., TN (USA)). Oct 1984. Contract AC05-84OR21400. 50p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85003815.

Technical progress is reported in the following areas: Breeder Reprocessing Engineering Test (BRET) project; process and engineering research and development; engineering systems; integrated equipment test (IET) facility operations; instrumentation and controls; strategic planning and analysis; and HTGR fuel reprocessing.

6448 **(ORNL/TM—9491) Consolidated Fuel Reprocessing Program. Progress report, July 1-September 30, 1984.** (Oak Ridge National Lab., TN (USA)). Nov 1984. 43p. NTIS, PC A03/MF A01. File Number DE85003720.

Technical progress is reported on the following: Breeder Reprocessing Engineering Test (BRET) Project; process and engineering research and development; engineering systems; integrated equipment test (IET) facility operations; instrumentation and controls; strategic planning and analysis; and HTGR fuel reprocessing.

6449 **(PNL—4981) Summary of nuclear fuel reprocessing activities around the world.** Mellinger, P.J.; Harmon, K.M.; Lakey, L.T. (Pacific Northwest Lab., Richland, WA (USA)). Nov 1984. Contract AC06-76RL01830. 106p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE85003662.

This review of international practices for nuclear fuel reprocessing was prepared to provide a nontechnical summary of the current status of nuclear fuel reprocessing activities around the world. The sources of information are widely varied.

6450 **Diluent degradation products in the Purex solvent.** Neace, J.C. (Allied-General Nuclear Services, Barnwell, SC). *Separation Science and Technology;* **18**: No. 14-15, 1581-1594(1983).

A number of laboratory tests were conducted in which various impurities, known to be present in degraded Purex solvent, were injected into fresh solvent samples and the effects of these impurities tested in an operating miniature pulse column and in batch contactors. Common fission product elements which interfere in the Purex process were spiked with radiotracers and added to the aqueous phase samples with which the test solvents were contacted. Process controls and blanks were used to verify test data. Periodically, samples of the organic phase were withdrawn for analyses by radiochemical means. From the data obtained, a number of theories were postulated on the mechanisms by which diluent degradation products interfere in the Purex process. 5 references, 4 figures, 2 tables.

6451 **Solvent extraction of plutonium(IV) polymer by dihexyl-N, N-diethyl-carbamoylmethylphosphonate (DHDECMP).** Muscatello, A.C.; Navratil, J.D.; Killion, M.E. (Rockwell International, Golden, CO). *Separation Science and Technology;* **18**: No. 14-15, 1731-1746(1983). Contract AC04-76DP03533.

The bifunctional organophosphorus compound DHDECMP (dihexyl-N, N-diethylcarbamoylmethylphosphonate) is effective in the extraction of hydrolytic plutonium(IV) polymer from both 0.04 and 7.0M nitric acid. Stripping the polymer is difficult, even with hydrofluoric acid. However, 1.0M sodium carbonate is a very effective stripping agent. The extracted complex contains one to two molecules of DHDECMP per plutonium ion and the plutonium(IV) maintains a polymeric structure. 15 references, 3 figures, 5 tables.

## 0509 Transport And Storage

*REFER ALSO TO CITATION(S) 0509006470*

6452 **(DOE/RW—0007) Transportation Business Plan: strategy options document.** (USDOE Office of Civilian Radioactive Waste Management, Washington, DC). Oct 1984. 24p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003262.

This document provides the framework for development of a business plan for establishing and operating the transportation system necessary to support a repository. Section I contains introductory material and defines the plan in terms of policy basis, purpose, and scope of business activities. Section II discusses the evolving strategy that will direct the Department's business actions and describes various strategy options that are under consideration. Also discussed in Section II is a process for the systematic development and acquisition of the transportation system. This process is based on a phased development approach with business activities divided into four stages: system definition; engineering development and certification; cask fleet procurement and carrier negotiations; and transportation operations. 8 figures, 2 tables.

6453 **(EGG-M—17584) Program in change: shipment of hazardous materials at the INEL.** Reed, L.L. (EG and G Idaho, Inc., Idaho Falls (USA)). 23 Aug 1984. Contract AC07-76ID01570. 10p. (CONF-840963—6). NTIS, PC A02. File Number DE85003417.

From DOE and DOE contractors' occupational safety and health conference; San Diego, CA, USA (11 Sep 1984).

Positive measures such as education, control, and auditing ability should be incorporated into each hazardous material shipping program to assure compliance with regulations and the safe movement of hazardous materials. This paper discusses these and other pertinent components of a shipping program. 3 references.

6454 **(EGG-M—23184) Fuel rod and crud behavior under long-term dry fuel storage conditions.** Olsen, C.S. (EG and G Idaho, Inc., Idaho Falls (USA)). 1984. Contract AC07-76ID01570. 25p. (CONF-841094—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003261.

From International workshop on irradiated fuel storage--operating experience and development programs; Toronto, Ontario, Canada (17 Oct 1984).

Eight commercial PWR and BWR spent fuel rods were tested to determine their long-term stability under a variety of possible dry storage conditions. The two-year test was comprised of three interim nondestructive examinations. This paper presents the results of the third examination conducted to determine any degradation in all eight fuel rods after being subjected to 13,168 h at temperatures between 502 K and 490 K. The PWR fuel rods showed no measurable change from the pretest condition. A BWR fuel rod replaced one that breached after the second interim examination, and a 1.9-cm crack developed in this rod at the bottom defect. About 17% cladding deformation was observed at the defect. Minute amounts of crud consisting of the $^{60}Co$ isotope fell into the fuel rod capsules. A small amount of fuel (0.1 g) from the breached BWR fuel rod was found in the capsules. The BWR fuel rod removed after the second interim examination was destructively examined. The fuel was oxidized to $U_3O_8$ in the area of the cladding

defect. The extensive fuel oxidation may result from diffusion of oxygen through the open porosity. The results of the testing with the BWR fuel would indicate that dry storage above 490 K to 502 K is not acceptable for this particular fuel used. This fuel may be atypical of current fuel design and fabrication techniques. The BWR results may not be applicable to PWR fuel because of the wide differences observed between PWR and BWR fuel rod behavior. The PWR fuel rods are being destructively examined to determine the extent of oxidation, but additional effort is required to determine oxidation mechanisms and identify the causes of the differences in behavior between PWR and BWR $UO_2$ fuel. Oxidation studies of other BWR fuel should be done to determine if the current observed behavior is unique to the BWR fuel before any generic licensing rules are established.

6455 **(EPRI-NP—3381-CCM-Vol.1) GFLOW thermal-hydraulic code. Volume 1. Spent-fuel pool licensing analysis and sensitivity studies.** Gay, R.R.; Gloski, D.M. (NUS Corp., Menlo Park, CA (USA)). Nov 1984. 79p. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $11.50. File Number TI85920105.

Under this project, a revised GFLOW computer code has been developed and verified making available much improved input and output features. A User's Manual has been written and is published separately. Three GFLOW models of the Maine Yankee spent fuel storage pool using 1584, 224 and 72 nodes were used to simulate pool thermal conditions and make comparison to experimental data. While all three models predicted maximum fluid temperature reasonably well, the 224 node model performed best predicting 100°F (38°C) maximum fluid temperature when the experimentally measured value was 102°F (39°C). Model characteristics near the inflow location appear to have a large influence on the predicted temperature distributions. A nominal licensing analysis performed using GFLOW resulted in a maximum coolant temperature of 161°F (71.7°C) only 7°F (4°C) above pool bulk temperature. Using the same power generation, a loss-of-cooling analysis was performed using GFLOW with an assumed top pool surface temperature of 212°F (100°C). A maximum temperature of 220°F (104.4°C) was predicted at the exit of the hottest fuel node. A model intended for direct comparison of GFLOW results to a previous RELAP4 licensing analysis was executed. The results indicated that while the RELAP4 analysis predicted a maximum fluid temperature 17°F (9°C) above the bulk pool temperature of 154°F (68°C), the GFLOW analysis predicted a value only 6°F (3°C) higher than the bulk pool temperature. GFLOW results were shown to be quite insensitive to local power densities and the values used for pressure loss coefficients in the fuel. The increased accuracy obtained using a stricter convergence criteria than that recommended was shown to be not economically justified. 3 references, 18 figures, 4 tables.

6456 **(EPRI-NP—3381-CCM-Vol.2) GFLOW thermal-hydraulic code. Volume 2. GFLOW user's manual.** Gay, R.R.; Gloski, D.M. (NUS Corp., Menlo Park, CA (USA)). Nov 1984. 129p. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $14.50. File Number TI85920106.

This text provides GFLOW users with the information required to correctly execute the code. Detailed descriptions of input variables and formats are given. A complete example problem is discussed, with its input deck and output results completely illustrated. Steady-state and stability considerations are also presented to aid the GFLOW user in obtaining satisfactory results.

6457 **(EPRI-NP—3764) Thermal-hydraulic analysis of consolidated spent PWR fuel rods. Final report.** Cuta, J.M.; Rector, D.R.; Creer, J.M. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Nov 1984. Contract AC06-76RL01830. 85p. NTIS, PC A05/MF A01 - EPRI; GPO Dep. File Number DE85003283.

Thermal-hydraulic calculations were performed with the COBRA-SFS computer code for single consolidated and unconsolidated spent PWR fuel assemblies. An arbitrary boundary of 121°C (250°F) was imposed on a wall 1 in. beyond the fuel tube containing a consolidation canister or unconsolidated fuel assembly. Air and helium were each considered as a possible storage medium for the two configurations. Cases were run to determine the effect on temperature distributions of geometry variations in both the consolidated and unconsolidated assembly. Axisymmetric and eccentric orientations were considered for each assembly. The effect of contact conductance was investigated by varying rod-to-rod, rod-to-wall, and wall-to-wall contact conductance in the various consolidated assembly geometries, with both air and helium. The results were evaluated by comparing the predicted radial temperature differences from the peak clad temperature to the boundary wall temperature for the various cases investigated. With air as the storage medium, the worst case for the consolidated assembly had a temperature drop about one-and-a-half times greater than that for the unconsolidated assembly (243°C versus 142°C). With helium as the storage medium, the worst case for the consolidated assembly had a significantly smaller temperature drop than that for the unconsolidated assembly (78°C versus 110°C). Variations in the geometry model and contact conductances can produce significant variations in the predicted temperature drop in the consolidated assembly, for both air and helium. Experimental data are needed to evaluate computer code models required to simulate consolidated assemblies. Analyses of multi-assembly storage systems are required to determine if the peak clad temperatures encountered with consolidated fuel will be within allowable limits. 9 references, 29 figures, 14 tables.

6458 (INIS-mf—9088, pp 19-54) **Transport and reprocessing of irradiated nuclear fuel. Present-day expertise and research program.** Lenail, B. (Compagnie Generale des Matieres Nucleaires (COGEMA), Centre de la Hague, 50 - Cherbourg (France)). 29 Sep 1981. (In Dutch). NTIS (US Sales Only), PC A07/MF A01. File Number TI85780140. (CONF-8109267—).

From Attainments in reprocessing and storage of fission wastes conference; Petten, Netherlands (29 Sep 1981).

This contribution deals with transport and packaging of oxide fuel from and to the Cogema reprocessing plant at La Hague (France). After a general discussion of nuclear fuel and the fuel cycle, the main aspects of transport and reprocessing of oxide fuel are analysed. 12 figures, 1 table.

6459 **(NUREG—0383-Vol.2-Rev.7) Directory of certificates of compliance for radioactive materials packages: certificates of compliance. Volume 2, Revision 7.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Fuel Cycle and Material Safety). Nov 1984. 641p. NTIS, PC A99/MF A01 - GPO* $11.00. File Number TI85900412.

This directory contains a Summary Report of NRC Approved Packages (Volume 1), Certificates of Compliance (Volume 2), and a Summary Report of NRC Approved Quality Assurance Programs for Radioactive Material Packages (Volume 3). The purpose of this directory is to make available a convenient source of information on packagings which have been approved by the US Nuclear Regulatory Commission. To assist in identifying packaging, an index by Model Number and corresponding Certificate of Compliance number is included at the back of each volume of the directory. The Summary Report includes a listing of all users of each package design prior to the publication date of the directory. Shipments of radioactive material utilizing these packagings must be in accordance with the provisions of 49 CFR 173.471 and 10 CFR Part 71, as applicable. In satisfying the requirements of Section 71.12, it is the responsibility of the licensees to insure that they have a copy of the current approval and conduct their transportation activities in accordance with an NRC approved quality assurance program. Copies of the current approval may be obtained from the US Nuclear Regulatory Commission Public Document Room files (see Docket No. listed on each certificate) at 1717 H Street, Washington, DC 20555. Note the general license of 10 CFR 71.12 does not authorize the receipt, possession, use or transfer of byproduct source, or special nuclear material; such authorization must be obtained pursuant to 10 CFR Parts 30 to 36, 40, 50, or 70.

6460 **(PNL—5236) Spent fuel shipping cask handling capability assessment of 27 selected light water reactors.** Konzek, G.J.; Daling, P.M. (Pacific Northwest Lab., Richland, WA (USA)). Nov 1984. Contract AC06-76RL01830. 63p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85003269.

This report presents an assessment of the spent fuel shipping cask handling capabilities of those nuclear plants currently projected to lose full core reserve capability in their spent fuel storage basins in the near future. The purpose of this assessment is to determine which cask types, in the current fleet, each of the selected reactors can handle. The cask handling capability of a nuclear plant depends upon both external and internal conditions at the plant. The availability of a rail spur, the lifting capacity of the crane, the adequacy of clearances in the cask receiving, loading, and decontamination areas and similar factors can limit the types of casks that can be utilized at a particular plant. This report addresses the major facility capabilities used in assessing the types of spent fuel shipping casks that can be handled at each of the 27 selected nuclear plants approaching a critical storage situation. The results of this study cannot be considered to be final and are not intended to be used to force utilities to ship by a particular mode. In addition, many utilities have never shipped spent fuel. Readers are cautioned that the results of this study reflect the current situation at the selected plants and are based on operator perceptions and guidance from NRC related to the control of heavy loads at nuclear power plants. Thus, the cask handling capabilities essentially represent snap-shots in time and could be subject to change as plants further analyze their capabilities, even in the near-term. The results of this assessment indicate that 48% of the selected plants have rail access and 59% are judged to be candidates for overweight truck shipments (with 8 unknowns due to unavailability of verifiable data). Essentially all of the reactors can accommodate existing legal-weight truck casks. 12 references, 1 figure, 4 tables.

6461 **(PNL—5284) Near-term commercial spent fuel shipping cask requirements.** Daling, P.M. (Pacific Northwest Lab., Richland, WA (USA)). Nov 1984. Contract AC06-76RL01830. 67p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85004343.

This report describes an analysis of the near-term commercial light water reactor (LWR) spent fuel transportation system. The objective was to determine if the existing commercial spent fuel shipping cask fleet is adequate to provide the needed transportation services for the period of time the US government would be authorized to accept spent fuel for Federal Interim Storage (FIS). A spent fuel shipping cask supply-demand analysis was performed to evaluate the existing fleet size. The results of the shipping cask handling capability study indicated that by weight, 75% of the spent fuel shipments will be by truck (overweight plus legal-weight truck). From the results of the shipping cask supply-demand analysis it was concluded that, if utilities begin large-scale applications for FIS, the five legal-weight truck (LWT) casks currently in service would be inadequate to perform all of the needed shipments as early as 1987. This further assumes that a western site would be selected for the FIS facility. If the FIS site were to be located in the East, the need for additional LWT casks would be delayed by about two years. The overweight truck (OWT) cask fleet (two PWR and two BWR versions) will be adequate through 1992 if some shipments to FIS can be made several years before a reactor is projected to lose full core reserve. This is because OWT cask requirements increase gradually over the next several years. The feasibility of shipping before losing full core reserve has not been evaluated. Cask utilization requirements in later years will be reduced if some shipments can be made prior to the time they are actually needed. The existing three rail casks are adequate to perform near-term shipments. 18 references, 4 figures, 18 tables.

## 0510 Marketing And Economics

*REFER ALSO TO CITATION(S) 0510006414*

6462 **(INIS-mf—9080) Summary case for mining and export of Australia's uranium deposits for peaceful uses in generation of electricity.** (Australian Mining Industry Council, Canberra). Apr 1984. 67p. NTIS (US Sales Only), PC A04/MF A01. File Number DE85780149.

Arguments in support of the mining and export of Australian uranium are presented. They concern economic development and export income; environmental advantages over fossil fuels; the existence of appropriate safety standards and procedures and of effective waste management procedures; and the potential, as a uranium exporter, to influence international discussions relating to safeguards. Chapters cover world statistics on nuclear power, sources of uranium, fuel cycle stages and related safety issues, environmental aspects of the fuel cycle, safeguards, high level waste management, the connection between nuclear power and nuclear weapons, and economic benefits to Australia.

6463 **Fiscal Year 1985 Department of Energy Authorization: uranium enrichment, electric energy systems, and storage programs. Volume VI. Hearings before the Subcommittee on Energy Research and Production of the Committee on Science and Technology, US House of Representatives, Ninety-Eighth Congress, Second Session, February 22, 28; March 1984.** Washington, DC, USA; Government Printing Office (1984). 330p.

Volume VI of the hearing record covers three days of testimony on uranium enrichment, electric energy systems, and storage problems. DOE Assistant Secretary for Nuclear Energy Shelby Brewer reviewed the current market crisis which threatens the US capability of continuing as a reliable enrichment supplier, and outlined DOE's response to the problem. Laboratory and non-DOE witnesses from the nuclear industry followed with their assessments of the problem. Witnesses on the third day described research on high-voltage electric fields, how electromagnetic pulses affect the electric grid, and ways to improve the delivery of electric power, as well as efficient, cost-effective energy-storage systems.

## 0520 Waste Management

*REFER ALSO TO CITATION(S) 0520006436, 6443, 6516, 6517, 6518, 6519, 6521, 6522, 6524, 6526, 6531, 6532, 6533, 6534, 6537, 7109, 7292, 7546, 7547, 7548, 7549, 7552, 7555*

6464 **(AECL—7822) Workshop on transitional processes: proceedings.** Heinrich, W.F. (comp.). (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment). May 1984. 308p. (CONF-8211198—). AECL-Scientific Document Dist. Office, Chalk River, Ontario, Canada $15.00. File Number TI84901541.

From Workshop on transitional processes; Ottawa, Canada (5 Nov 1982).

Work performed under Canada/US Waste Management Information Exchange Agreement.

This workshop was arranged, as part of the Canadian Nuclear Fuel Waste Management Program, to examine some aspects of the natural history of the Canadian Shield that could have a bearing on the disposal of nuclear fuel waste deep in plutonic rock in the Shield. It also focused on probable future climatic and geological processes that could affect radionuclide transport through the geosphere, the major barrier between a disposal vault and the biosphere. This report contains the papers presented at the workshop and some of the discussions that followed the presentations.

6465 **(AECL—8361) Geochemistry of high-level waste disposal in granitic rocks.** Chapman, N.A.; Sargent, F.P. (eds.). (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment). Jul 1984. 113p. (EUR—9162; CONF-8309306—). AECL-Scientific Document Dist. Office, Chalk River, Ontario, Canada $5.00. File Number TI84901833.

From Geochemistry of high-level waste disposal in granitic rocks workshop; Oxford, UK (12 Sep 1983).

Work performed under Canada/US Waste Management Information Exchange Agreement.

Seven major topics were presented, discussed and documented. The major conclusions were: waste-form leaching and dissolution models should be superseded by solubility limits and water availability models; direct and significant migration of radionuclides from waste forms as colloids is unlikely under disposal conditions; most of the sorption data required to model the retardation of radionuclide migration in the geosphere are available; there is a need to better characterize the solid phases that sorb radionuclides and to determine their stability and kinetics of dissolution; the linear programming method is proving invaluable for refining thermodynamic data bases for predicting the stability of the rock-forming miner-

als; it is recognized that the almost complete lack of good thermodynamic data for iron-containing minerals is a serious deficiency; the discovery of highly saline groundwaters at many sites in Canada has suggested that these occur throughout the Canadian Shield at depths below about 500 m; most of the components of a fully coupled groundwater flow/geochemical mass transport model are currently available; the potential effects of microbial activity on the release of radionuclides seem to be most important in the near field; and natural analogs should be used to support all models and to justify the extrapolation of short-term observations to geological time scales.

6466 **(ANL/EES-TM—263) Radioactive waste isolation in salt: peer review of the Office of Nuclear Waste Isolation's reports on multifactor life testing of waste package materials.** McPheeters, C.C.; Harrison, W.; Ditmars, J.D.; Lerman, A.; Rote, D.M.; Edgar, D.E.; Hambley, D.F. (Argonne National Lab., IL (USA)). Sep 1984. Contract W-31-109-ENG-38. 49p. NTIS, PC E02/MF A01; GPO Dep. File Number DE85000692.

Includes 1 sheet of 24x reduction microfiche.

Two documents that provide the approaches in designing a test program to investigate uniform corrosion of low-carbon cash steel in a salt repository environment were reviewed. Recommendations are made by the Peer Review Panel for improving the two reports.

6467 **(CONF-8409115—Absts.) Sixth annual DOE LLWMP Participants' Information Meeting.** (Oak Ridge National Lab., TN (USA)). 1984. Contract AC05-84OR21400. 79p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE84016490.

From 6. annual Low-Level Waste Management Program participants' information meeting; Denver, CO, USA (11 Sep 1984).

Papers were presented at the following sessions: Improved Shallow Land Burial; Greater Confinement Disposal; Corrective Measures Technology; Characteristics and Treatment of Low-Level Waste; and Environmental Aspects and Performance Prediction. Three workshops were held: Predicting Source Terms for Low-Level Waste; Performance Assessment for Low-Level Disposal Facilities; and Approaches to Low-Level Disposal Facility Siting and Characterization.

6468 **(DOE/ID—22067) Description and hydrogeologic implications of cored sedimentary material from the 1975 drilling program at the Radioactive Waste Management Complex, Idaho.** Rightmire, C.T. (Geological Survey, Idaho Falls, ID (USA)). Aug 1984. Contract AI07-81ID12306. 39p. (USGS/WRI—84-4071). NTIS, PC A03/MF A01; GPO Dep. File Number DE85002168.

Samples of sedimentary material from interbeds between basalt flows and from fractures in the flows, taken from two drill cores at the Radioactive Waste Management Complex at the Idaho National Engineering Laboratory were analyzed for (1) particle-size distribution, (2) bulk mineralogy, (3) clay mineralogy, (4) cation-exchange capacity, and (5) carbonate content. Thin sections of selected sedimentary material were made for petrographic examination. These analyses are needed for a characterization of paths and rates of movement of radionuclides transported by infiltrating water. Preliminary interpretations indicate that (1) it may be possible to distinguish the various sedimentary interbeds on the basis of their mineralogy, (2) the presence of carbonate horizons in sedimentary interbeds may be utilized to approximate the time of exposure and the climate while the surface was exposed, and (3) the type and orientation of fracture-filling material may be utilized to determine the mechanism by which fractures were filled. 9 references, 14 figures, 8 tables.

6469 **(DOE/ID/12437—1) Low-level waste workshops. Final report.** (Council of State Governments, Chicago, IL (USA)). 1983. Contract FG07-83ID12437. 53p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85001838.

The Low-Level Radioactive Waste Policy Act of 1980 specifies that each state is responsible for the disposal of the low-level waste which is generated within its boundaries. The Act states that such wastes can be most safely and efficiently managed on a regional basis through compacts. It also defines low-level waste as waste which is not classified as high-level radioactive waste, transuranic waste, spent nuclear fuel, or by-product material as defined in the Atomic Energy Act of 1954. The Policy Act also stipulates that regional agreements or compacts shall not be applicable to the transportation, management, or disposal of low-level radioactive waste from atomic energy defense activities or federal research and development activities. It also specifies that agreements or compacts shall take affect on January 1, 1986, upon Congressional approval. In February 1983, the US Department of Energy awarded a grant to the Council of State Governments' Midwestern Office. The grant was to be used to fund workshops for legislation on low-level radioactive waste issues. The purpose of the workshops was to provide discussion specifically on the Midwest Interstate Compact on Low-Level Radioactive Waste. Legislators from the states which were eligible to join the compact were invited: Delaware, Illinois, Indiana, Iowa, Kentucky, Maryland, Michigan, Minnesota, Missouri, North Dakota, Ohio, South Dakota and Wisconsin. Virginia, Kansas and Nebraska were also eligible but had joined other compacts. Consequently, they weren't invited to the workshops. The Governor's office of West Virginia expressed interest in the compact, and its legislators were invited to attend a workshop. Two workshops were held in March. This report is a summary of the proceedings which details the concerns of the compact and expresses the reasoning behind supporting or not supporting the compact.

6470 **(DOE/NV/10250—16) Commercial Nuclear Waste Research and Development Program. Quarterly report, July-September 1984.** (Westinghouse Electric Corp., Mercury, NV (USA). Waste Technology Services Div.). Oct 1984. Contract AC08-82NV10250. 39p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85003882.

Activities performed during the fourth quarter of Fiscal Year 1984 to meet task objectives of the Nevada Nuclear Waste Storage Investigations FY 1984 Project Plan are reported. Noteworthy accomplishments include: All Fiscal Year 1984 semiannual fuel integrity monitoring gas sampling of welded canisters was completed. Remote fuel handling operations were conducted on fuel assemblies B43 and D34 to perform integrity monitoring swipe sampling. Results were received: no indication of fuel rod integrity violation was noted. A Quality Assurance audit of WTSD-Nevada Operations activities and records was conducted by a DOE/NV and SAI audit team. No findings were reported in the exit interview. An Interim Report of Fiscal Year 1984 Task 12 activities was completed and submitted to DOE/NV as a Contract Deliverable. The midyear report of fuel integrity monitoring activities, with an assessment of the condition of the 17 fuel assemblies in use at the E-MAD facility, was prepared and transmitted to DOE/NV. Parameter search welds were completed on the Hobart plasma arc welder on 0.25-in.-thick and 0.375-in.-thick stainless steel material. The welds in the 0.25-in.-thick material appeared to be satisfactory; those in the 0.375-in.-thick material were not acceptable due to intermittent gas entrainment in the weld. The summary report of all activities performed to retrieve the Material Interaction Test capsules from fuel assemblies B03, D01, D04, and D06 was completed and transmitted to DOE/NV. Support was provided for preparation of the SP-100 (space station) testing program proposal being prepared by DOE/NV. A summary recommendation for disassembly and consolidation of spent fuel at E-MAD was prepared and transmitted to DOE/NV. The WTSD-Nevada Operations Quality Assurance Plan was updated to comply with NVO-196-17, Revision 2.

6471 **(DOE/RW—0006) Spent fuel and radioactive waste inventories, projections, and characteristics.** (Oak Ridge National Lab., TN (USA)). Sep 1984. Contract AC05-84OR21400. 211p. NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE85003443.

Current inventories and characteristics of commercial spent fuels and both commercial and US Department of Energy (DOE) radioactive wastes were compiled through December 31, 1983, based on the most reliable information available from government sources and the open literature, technical reports, and direct contacts. Future waste and spent fuel to be generated over the next 37 years and characteristics of these materials are also presented, con-

sistent with the latest DOE/Energy Information Administration (EIA) or projection of US commercial nuclear power growth and expected defense-related and private industrial and institutional activities. Materials considered, on a chapter-by-chapter basis, are: spent fuel, high-level waste, transuranic waste, low-level waste, commercial uranium mill tailings, airborne waste, remedial action waste, and decommissioning waste. For each category, current and projected inventories are given through the year 2020, and the radioactivity and thermal power are calculated, based on reported or calculated isotopic compositions. 48 figures, 107 tables.

6472 **(DP-MS—84-86) High-level waste processing and disposal.** Crandall, J.L.; Krause, H.; Sombret, C.; Uematsu, K. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Nukleare Entsorgungstechnik; CEA Centre de Marcoule, 30 - Bagnols-sur-Ceze (France); Power Reactor and Nuclear Fuel Development Corp., Tokyo (Japan)). 1984. Contract AC09-76SR00001. 35p. (CONF-841105—48). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85003564.

From Joint meeting of the American Nuclear Society and the Atomic Industrial Forum; Washington, DC, USA (11 Nov 1984).

The national high-level waste disposal plans for France, the Federal Republic of Germany, Japan, and the United States are covered. Three conclusions are reached. The first conclusion is that an excellent technology already exists for high-level waste disposal. With appropriate packaging, spent fuel seems to be an acceptable waste form. Borosilicate glass reprocessing waste forms are well understood, in production in France, and scheduled for production in the next few years in a number of other countries. For final disposal, a number of candidate geological repository sites have been identified and several demonstration sites opened. The second conclusion is that adequate financing and a legal basis for waste disposal are in place in most countries. Costs of high-level waste disposal will probably add about 5 to 10% to the costs of nuclear electric power. The third conclusion is less optimistic. Political problems remain formidable in highly conservative regulations, in qualifying a final disposal site, and in securing acceptable transport routes.

6473 **(DP-MS—84-110) Saltstone: cement-based waste form for disposal of Savannah River Plant low-level radioactive salt waste.** Langton, C.A. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1984. Contract AC09-76SR00001. 18p. (CONF-841187—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85002831.

From 5. DOE environmental protection information meeting; Albuquerque, NM, USA (6 Nov 1984).

Defense waste processing at the Savannah River Plant will include decontamination and disposal of approximately 400 million liters of waste containing $NaNO_3$, NaOH, $Na_2SO_4$, and $NaNO_2$. After decontamination, the salt solution is classified as low-level waste. A cement-based waste form, saltstone, has been designed for disposal of Savannah River Plant low-level radioactive salt waste. Bulk properties of this material have been tailored with respect to salt leach rate, permeability, and compressive strength. Microstructure and mineralogy of leached and unleached specimens were characterized by SEM and x-ray diffraction analyses. The disposal system for the DWPF salt waste includes reconstitution of the crystallized salt as a solution containing 32 wt % solids. This solution will be decontaminated to remove $^{137}Cs$ and $^{90}Sr$ and then stabilized in a cement-based waste form. Laboratory and field tests indicate that this stabilization process greatly reduces the mobility of all of the waste constitutents in the surface and near-surface environment. Engineered trenches for subsurface burial of the saltstone have been designed to ensure compatibility between the waste form and the environment. The total disposal sytem, saltstone-trench-surrounding soil, has been designed to contain radionuclides, Cr, and Hg by both physical encapsulation and chemical fixation mechanisms. Physical encapsulation of the salts is the mechanism employed for controlling N and OH releases. In this way, final disposal of the SRP low-level waste can be achieved and the quality of the groundwater at the perimeter of the disposal site meets EPA drinking water standards.

6474 **(DPST—84-1-8) Savannah River Laboratory monthly report, August 1984.** (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Aug 1984. Contract AC09-76SR00001. 19p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85001200.

Reported are: waste disposal optimization; aromatic hydrocarbons in the DWPF glass melter; materials of construction for DWPF feed equipment; site selection for m-area saltstone disposal; new production reactor; redesign of the L-area outfall; reactor fuel production facility; small calciner tests in support of onsite uranium recycle; processing in the multi-purpose processing facility; dissolution of SRF uranium-aluminium alloy scrap; fault tree analysis for dissolving SEFOR fuel; transuranic waste management; and FB/HB radiation shielding studies.

6475 **(EGG—2291) Decontamination and decommissioning of the SPERT-I seepage pit at the Idaho National Engineering Laboratory. Final report.** Suckel, R.A. (EG and G Idaho, Inc., Idaho Falls (USA)). Nov 1984. Contract AC07-76ID01570. 30p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85003273.

This report describes the decontamination and decommissioning of the SPERT-I seepage pit. Prior to its decontamination and decommissioning, the seepage pit was surrounded by an earthen dike varying from 2 to 6 ft above the pit bottom. A 6-in., cast iron, underground waste line originated at the pit tank in the reactor building and ran approximately 68 ft to the seepage pit. The soil in the seepage pit contained low-level radioactive contamination. The soil surface was removed to a depth of 2.5 ft and shipped to the Radioactive Waste Management Complex (RWMC). The waste line that contained fixed contamination was removed and also sent to the RWMC. The pit was backfilled with radiologically clean soil, reducing the surface activity to background. A permanent marker was erected over the backfilled pit to indicate that presence of residual subsurface radioactive contamination. 5 references, 26 figures, 3 tables.

6476 **(EGG—2321) Annual technology assessment and progress report for the buried transuranic waste program at the Idaho National Engineering Laboratory.** Berreth, P.D. (EG and G Idaho, Inc., Idaho Falls (USA)). Nov 1984. Contract AC07-76ID01570. 14p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85003155.

The US Department of Energy (DOE) is responsible for developing and implementing methods for the safe and environmentally acceptable disposal of radioactive waste. In 1983, DOE formulated a comprehensive plan to manage transuranic (TRU) defense waste. The DOE plan for buried TRU waste is to monitor it, take remedial actions as necessary, and reevaluate its safety periodically. The DOE strategy reflects concern that, based on present technology, retrieval and processing of buried waste may be risky and costly. To implement the DOE plan, EG and G Idaho, Inc., prime contractor at the Idaho National Engineering Laboratory (INEL), has developed a strategy for long-term management of the 2 million cubic feet of INEL buried TRU waste. That strategy involves four main activities: (a) environmental monitoring, (b) remedial action if necessary, (c) assimilation of data from both special studies and ongoing waste management activities, and (d) selection of a long-term management alternative in 1995. This report, submitted as the first in a series of annual reports, summarizes the buried TRU waste activities performed in fiscal year (FY) 1984 at the INEL in response to the DOE plan. Specifically, technologies applicable to buried waste confinement, retrieval, certification, and processing have been assessed, a long-range plan to conduct buried wasted studies over the next ten years has been prepared, and retrieval and soil management alternatives have been evaluated. 17 references, 7 figures, 1 table.

6477 **(EGG—2350) Long-range plan for buried transuranic waste studies at the Idaho National Engineering Laboratory.** Berreth, P.D.; Fischer, D.K.; Suckel, R.A. (EG and G Idaho, Inc., Idaho Falls (USA)). Nov 1984. Contract AC07-76ID01570. 31p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85002861.

This document presents a plan to perform detailed studies of alternatives considered for the long-term management of buried transuranic waste at the INEL. The studies will provide the technical basis for DOE to make a decision on the future management of that waste. Although the waste is currently being handled in an acceptable manner, new solutions are continually being researched to improve handling techniques. Three alternatives are being considered: (a) leave the waste as is; (b) improve in situ confinement of the waste; (c) retrieve, process, and certify the waste for disposal at a federal repository. Fifteen studies are described in this plan for the latter two alternatives. The leave-as-is alternative involves continuing present procedures for managing the buried waste. An ongoing environmental surveillance program, a low-level-waste stabilization program, and enhanced subsurface migration studies begun in FY-1984 at the INEL will provide data for the decision-making process for INEL buried TRU waste. These ongoing studies for the leave-as-is alternative are summarized in this plan in limited detail. The improved-confinement alternative involves leaving the waste in place, but providing additional protection against wind water penetration, erosion, and plant and animal intrusion. Several studies proposed will examine special techniques to immobilize or encapsulate the buried waste. Studies of the third alternative will investigate improved retrieval, processing and certification techniques. New equipment, such as industrial manipulators and excavating machinery, will be tested in the retrieval studies. Processing and certification studies will examine rapidly changing or new technologies. 19 references, 8 figures, 4 tables.

6478 **(EGG-M—15184) Development and implementation of the Low-Level Radioactive Waste Policy Act.** Downs, K.F.; Coleman, J.A. (EG and G Idaho, Inc., Idaho Falls (USA); Department of Energy, Washington, DC (USA)). 1984. Contract AC07-76ID01570. 5p. (CONF-841105—44). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003265.

From Joint meeting of the American Nuclear Society and the Atomic Industrial Forum; Washington, DC, USA (11 Nov 1984).

The Low-Level Radioactive Waste Policy Act, passed in December 1980, was a major step in initiating the establishment of a national system for the management of commercially generated low-level radioactive waste. States have made considerable progress in developing the institutional structures needed as a framework for developing regional disposal sites. Nearly 40 states have enacted legislation in response to the 1980 Policy Act and four regions have submitted compacts for Congressional approval. However, Congressional consent to these compacts has not been obtained. Efforts to implement the Policy Act are at a critical juncture. Since passage of the Policy Act, the DOE Low-Level Waste Management Program has focused on facilitating establishment of an effective low-level waste management system, and improving waste disposal technology and safety regulations. The Program is involved in developing improved waste disposal and treatment technology and improved waste disposal requirements for the selection and operation of DOE disposal facilities, and in providing support to states and regions for development of new institutional structures that will lead to siting and operating new low-level waste disposal facilities. 1 figure.

6479 **(EGG-M—23284) Waste classification: a management approach.** Wickham, L.E. (EG and G Idaho, Inc., Idaho Falls (USA)). 1984. Contract AC07-76ID01570. 6p. (CONF-8409115—16). NTIS, PC A02/F A01; 1; GPO Dep. File Number DE85003400.

From 6. annual Low-Level Waste Management Program participants' information meeting; Denver, CO, USA (11 Sep 1984).

A waste classification system designed to quantify the total hazard of a waste has been developed by the Low-Level Waste Management Program. As originally conceived, the system was designed to deal with mixed radioactive waste. The methodology has been developed and successfully applied to radiological and chemical wastes, both individually and mixed together. Management options to help evaluate the financial and safety trade-offs between waste segregation, waste treatment, container types, and site factors are described. Using the system provides a very simple and cost effective way of making quick assessments of a site's capabilities to contain waste materials. 3 references.

6480 **(EGG-M—23584) Approach to DOE threshold guidance limits.** Shuman, R.D.; Wickham, L.E. (EG and G Idaho, Inc., Idaho Falls (USA)). 1984. Contract AC07-76ID01570. 7p. (CONF-8409115—15). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003424.

From 6. annual Low-Level Waste Management Program participants' information meeting; Denver, CO, USA (11 Sep 1984).

The need for less restrictive criteria governing disposal of extremely low-level radioactive waste has long been recognized. The Low-Level Waste Management Program has been directed by the Department of Energy (DOE) to aid in the development of a threshold guidance limit for DOE low-level waste facilities. Project objectives are concernd with the definition of a threshold limit dose and pathway analysis of radionuclide transport within selected exposure scenarios at DOE sites. Results of the pathway analysis will be used to determine waste radionuclide concentration guidelines that meet the defined threshold limit dose. Methods of measurement and verification of concentration limits round out the project's goals. Work on defining a threshold limit dose is nearing completion. Pathway analysis of sanitary landfill operations at the Savannah River Plant and the Idaho National Engineering Laboratory is in progress using the DOSTOMAN computer code. Concentration limit calculations and determination of implementation procedures shall follow completion of the pathways work. 4 references.

6481 **(GSF-T—164) Evaluation of diameter measurements performed on the casing and tubing of shaft 4 in the Asse pit.** Staupendahl, G. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.)). Oct 1983. 75p. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE84752285.

Out-of-round of casing and tubing as observed so far, amounts to less than 3.1 mm in all instances with the greatest out-of-round values to be found at the deepest measurement horizon in the cover rock. In-situ examinations show that there is a slight torsion with casing and tubing in the salinary owing to construction. The article gives the results of ultrasonic wall-width measurements performed on the casing and tubing by means of the pulse-echo method.

6482 (INIS-mf—9088, pp 55-79) **Solid, liquid and gaseous wastes of a fuel reprocessing plant.** Thiry, B. (Compagnie Generale des Matieres Nucleaires (COGEMA), Centre de la Hague, 50 - Cherbourg (France)). 29 Sep 1981. (In Dutch). NTIS (US Sales Only), PC A07/MF A01. File Number TI85780140. (CONF-8109267—).

From Attainments in reprocessing and storage of fission wastes conference; Petten, Netherlands (29 Sep 1981).

At La Hague (France), two new fuel reprocessing plants will be built in the near future, UP2 800 and UP3 A. Both plants, destined to reprocess fuels from the light-water reactor family, will produce wastes in solid, liquid and gaseous form. In the first part of this contribution, the quantities of the various wastes of these plants and their management are discussed. The solid wastes are classified according to the packaging method. In addition, a brief description is given of how the wastes of the existing French plants, UP1 at Marcoule and UP2 at La Hague, are managed.

6483 (INIS-mf—9088, pp 5-17) **Outlook of the fission waste problem.** Goedkoop, J.A. (Stichting Energieonderzoek Centrum Nederland, Petten). 29 Sep 1981. (In Dutch). NTIS (US Sales Only), PC A07/MF A01. File Number TI85780140. (CONF-8109267—).

From Attainments in reprocessing and storage of fission wastes conference; Petten, Netherlands (29 Sep 1981).

As an introduction, the author describes in this paper what kinds of radioactive wastes there are and in which quantities. He describes various methods of their storage and disposal. Packaging in concrete and in glass is discussed, as well as underground (salt caverns) and overground storage. In a separate section, the Dutch research projects are listed.

6484 (INIS-mf—9088, pp 80-127) **Outline of the present-day investigations into the ultimate disposal of fission wastes in salt caverns.** Vons, L.H. (Stichting Energieonderzoek Centrum Nederland, Petten). 29 Sep 1981. (In Dutch). NTIS (US Sales Only), PC A07/MF A01. File Number TI85780140. (CONF-8109267—).

From Attainments in reprocessing and storage of fission wastes conference; Petten, Netherlands (29 Sep 1981).

In this contribution, the ECN investigations into the disposal of fission wastes in salt caverns is described. Different designs of borehole-configurations in mines are discussed. Temperature calculations are carried out for various decay times. Next, the procedure of a dry-drill experiment in the Asse-II mine is presented as well as the measuring program and results. Some future activities are listed in the final section. It is concluded that no other temperature calculations are needed. Deformation calculations show good agreement with experiments. In-situ experiments will be very relevant but they are as yet very difficult. In view of the successful drill experiment, the configuration studied here possibly offers a solution of fuel disposal problems.

6485 (INIS-mf—9088, pp 128-148) **Safety of radioactive waste disposal in salt caverns.** Hamstra, J. (Stichting Energieonderzoek Centrum Nederland, Petten). 29 Sep 1981. (In Dutch). NTIS (US Sales Only), PC A07/MF A01. File Number TI85780140. (CONF-8109267—).

From Attainments in reprocessing and storage of fission wastes conference; Petten, Netherlands (29 Sep 1981).

From recent geological studies of the evolution of salt caverns in the German part of the Zechstein basin, the maximal salt drift velocity is at most 0.4 mm/y. This value is much smaller than the value 2.5 mm/y used by the Dutch ICK committee charged with the examination of the disposal problem. In this paper, it is argued that a lower drift value has very advantageous effects on results of safety calculations. It is further argued that some realistic changes of the disposing geometry increase the safety substantially as compared with model calculations by the ICK. It is concluded that radioactive wastes may be disposed in salt caverns.

6486 (INIS-mf—9099) **Quality assurance in processing radioactive waste for land disposal.** (Department of the Environment, London (UK)). 1984. 12p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85780181.

To provide the appropriate assurances as to the quality of processed radioactive waste it is necessary to consider the complete range of activities involved in the formation and operation of a radioactive waste processing facility. To this end, an outline has been given to the individual elements which should be addressed in quality assurance proposals to the authorising Departments. In general terms, the quality checks on product material should be aimed at demonstrating that the radioactive waste product is what was agreed at the time of process approval. In addition, at the discretion of the authorising Departments, the waste processor will be required to confirm that the product meets any specific acceptance criteria such as the capability to retain the immobilised radionuclides when in contact with water.

6487 (LA—10032-PR) **Research and development related to the Nevada Nuclear Waste Storage Investigations. Progress report, October 1-December 31, 1983.** Wolfsberg, K.; Vaniman, D.T. (comps.). (Los Alamos National Lab., NM (USA)). Aug 1984. Contract W-7405-ENG-36. 78p. NTIS, PC A05/MF A01; GPO Dep. File Number DE85002303.

This report summarizes the contribution of the Los Alamos National Laboratory to the Nevada Nuclear Waste Storage Investigations for the first quarter of FY 1984. The status of the following studies is given: geochemistry of tuff; mineralogy-petrology of tuff; tectonics and volcanism; tuff laboratory properties; sealing materials evaluation; and quality assurance. 47 references, 21 figures, 12 tables.

6488 (LBL—18473) **Hydrologic mechanisms governing fluid flow in partially saturated, fractured, porous tuff at Yucca Mountain.** Wang, J.S.Y.; Narasimhan, T.N. (Lawrence Berkeley Lab., CA (USA)). Oct 1984. Contract AC03-76SF00098. 58p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85004445.

In contrast to the saturated zone where fluid moves rapidly along fractures, the fractures (with apertures large relative to the size of matrix pores) will desaturate first during drainage process and the bulk of fluid flow would be through interconnected pores in the matrix. Within a partially drained fracture, the presence of a relatively continuous air phase will produce practically an infinite resistance to liquid flow in the direction parallel to the fracture. The residual liquid will be held by capillary force in regions around fracture contact areas where the apertures are small. Normal to the fracture surfaces, the drained portion of the fractures will reduce the effective area for liquid flow from one matrix block to another matrix block. A general statistical theory is constructed for flow along the fracture and for flow between the matrix blocks to the fractures under partially saturated conditions. Results are obtained from an aperture distribution model for fracture saturation, hydraulic conductivity, and effective matrix-fracture flow areas as functions of pressure. Drainage from a fractured tuff column is simulated. The parameters for the simulations are deduced from fracture surface characteristics, spacings and orientations based on core analyses, and from matrix characteristics curve based on laboratory measurements. From the cases simulated for the fractured, porous column with discrete vertical and horizontal fractures and porous matrix blocks explicitly taken into account, it is observed that the highly transient changes from fully saturated conditions to partially saturated conditions are extremely sensitive to the fracture properties. However, the quasi-steady changes of the fluid flow of a partially saturated, fractured, porous system could be approximately simulated without taking the fractures into account. 22 references, 16 figures.

6489 (NUREG/CP—0055) **State workshop on shallow land burial and alternative disposal concepts: proceedings.** (Nuclear Regulatory Commission, Washington, DC (USA)). Oct 1984. 383p. (CONF-8405253—). NTIS, PC A17/MF A01 - GPO* $8.50. File Number TI85900384.

From State workshop on shallow land burial and alternative disposal concepts; Bethesda, MD, USA (2 May 1984).

Three of the major conclusions reached by state participants were the following: (1) Significant data gaps and information needs have to be addressed before timely state decisionmaking can be accomplished. State participants felt a generic cost/risk/benefit analysis for all viable alternatives would be useful and might best be performed by the federal government on behalf of the states. (2) Recognizing the imprecision in summarizing overall attitudes of the workshop participants, alternative disposal concepts that appear to be the most favorably perceived when rank ordered by critical factors are augered holes with liners, belowground vaults, earth mounded concrete bunkers, aboveground vaults and mined cavities. (3) The public appears to place greater confidence in disposal methods that incorporate man-made engineered barriers because of some past problems at closed shallow land burial facilities. Concern was expressed by workshop participants that the public may not consider the perceived risks associated with shallow land burial to be acceptable. In addition to the four 10 CFR Part 61, Subpart C performance objectives, public acceptance of risk was considered to be a critical factor by state officials in selecting a disposal technology. The states should take the lead in pursuing development-oriented analyses, such as detailed concept engineering and economic feasibility studies. It is not within the purview of NRC responsibility to undertake such studies.

6490 (NUREG/CR—3864) **Characterization of the low-level radioactive wastes and waste packages of General Electric Vallecitos Nuclear Center. Final report.** Kempf, C.R.; MacKenzie, D.R.; Bowerman, B.S.; Dougherty, D.R.; Siskind, B. (Brookhaven National Lab., Upton, NY (USA)). Nov 1984. Contract AC02-76CH00016. 93p. (BNL-NUREG—51791). NTIS, PC A05/MF A01 - GPO $4.75. File Number TI85003512.

An evaluation of the low-level wastes and waste packages generated by General Electric Vallecitos Nuclear Center (GEVNC) was made on the basis of 10 CFR Part 61 criteria and on the Technical Position on Waste Form (TP). In addition, a review has been performed of the handling and storage methods used by GEVNC for their transuranic wastes. Several options have been discussed for management of these materials. This evaluation was the result of a study initiated by the US Nuclear Regulatory Commission (NRC), in which GEVNC participated. GEVNC generates radioactive wastes in hot cell processes which include examination of reactor fuel and components, and production of sources and radiopharmaceuticals. These wastes are usually Class B or greater. Class A wastes result from support activities which include maintenance of the hot cells. The dominant contaminating radioisotopes are Cs-137 and Co-60. In addition, transuranic wastes result from examination and burnup analyses of fuel. The latter wastes are all currently stored on-site at GEVNC. The low activity Class A, Cs-137 and Co-60 dominated wastes are generally packaged in 55-gallon drums and wooden boxes, while those of higher activity (Class B and greater) are packaged in 84-gallon extended 17H drums that are grouted with cement. The Class A packages meet the requirements in 10 CFR Part 61. The Class B and greater grouted drum packages have been evaluated with respect to meeting the stability requirements in 10 CFR Part 61 and with respect to the guidance in the TP. Based on the evaluation, overall, the waste forms of these packages are expected to maintain their stability, but a few concerns are identified and testing should be performed by GEVNC to demonstrate waste form stability. 57 references, 16 tables.

6491 **(NUREG/CR—3973) Alternative containers for low-level wastes containing large amounts of tritium.** Gause, E.P.; Lee, B.S.; MacKenzie, D.R.; Wiswall, R. Jr. (Brookhaven National Lab., Upton, NY (USA)). Nov 1984. Contract AC02-76CH00016. 149p. (BNL-NUREG—51814). NTIS, PC A07/MF A01 - GPO $5.50. File Number TI85003312.

High-activity tritiated waste generated in the United States is mainly composed of tritium gas and tritium-contaminated organic solvents sorbed onto Speedi-Dri which are packaged in small glass bulbs. Low-activity waste consists of solidified and adsorbed liquids. In this report, current packages for high-activity gaseous and low-activity adsorbed liquid wastes are emphasized with regard to containment potential. Containers for low-level radioactive waste containing large amounts of tritium need to be developed. An integrity may be threatened by: physical degradation due to soil corrosion, gas pressure build-up (due to radiolysis and/or biodegradation), rapid permeation of tritium through the container, and corrosion from container contents. Literature available on these points is summarized in this report. 136 references, 20 figures, 40 tables.

6492 **(NUREG/CR—3993) Geochemical investigations at Maxey Flats radioactive waste disposal site.** Dayal, R.; Pietrzak, R.F.; Clinton, J. (Brookhaven National Lab., Upton, NY (USA)). Sep 1984. Contract AC02-76CH00016. 139p. (BNL-NUREG—51820). NTIS, PC A07/MF A01 - GPO. File Number TI85001290.

As part of the NRC efforts to develop a data base on source term characteristics for low level wastes, Brookhaven National Laboratory (BNL) has produced and analyzed a large amount of data on trench leachate chemistry at existing shallow land burial sites. In this report, we present the results of our investigations at the Maxey Flats, Kentucky disposal site. In particular, data on trench leachate chemistry are reviewed and discussed in terms of mechanisms and processes controlling the composition of trench solutes. Particular emphasis is placed on identifying both intra- and extra-trench factors and processes contributing to source term characteristics, modifications, and uncertainties. BNL research on the Maxey Flats disposal site has provided important information not only on the source term characteristics and the factors contributing to uncertainties in the source term but also some generic insights into such geochemical processes and controls as the mechanics of leachate formation, microbial degradation and development of anoxia, organic complexation and radionuclide mobility, redox inversion and modification of the source term, solubility constraints on solute chemistry, mineral authigenesis, corrosion products and radionuclide scavenging, and the role of organic complexants in geochemical partitioning of radionuclides. A knowledge of such processes and controls affecting the geochemical cycling of radionuclides as well as an understanding of the important factors that contribute to variability and uncertainties in the source term is essential for evaluating the performance of waste package and the site, making valid predictions of release for dose calculations, and for planning site performance monitoring as well as remedial actions. 43 references, 47 figures, 30 tables.

6493 **(ORNL/TM—9259) Anaerobic digestion of cellulosic wastes: laboratory tests.** Lee, D.D.; Donaldson, T.L. (Oak Ridge National Lab., TN (USA)). Nov 1984. Contract AC05-84OR21400. 56p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85003814.

Anaerobic digestion is a potentially attractive technology for volume reduction of cellulosic wastes. A substantial fraction of the waste is converted to off-gas and a relatively small volume of biologically stabilized sludge is produced. Process development work is underway using a 75-L digester to verify rates and conversions obtained at the bench scale, to develop start-up and operating procedures, and to generate effluent for characterization and disposal studies. Three runs using batch and batch-fed conditions have been made lasting 36, 90, and over 200 days. Solids solubilization and gas production rates and total solids destruction have met or exceeded the target values of 0.6 g cellulose per L of reactor per day, 0.5 L off-gas per L of reactor per day, and 80% destruction of solids, respectively. Successful start-up procedures have been developed, and preliminary effluent characterization and disposal studies have been done. A simple dynamic process model has been constructed to aid in further process development and for use in process monitoring and control of a large-scale digester. 10 references, 17 figures, 4 tables.

6494 **(PNL—4250-5) Nuclear waste management. Semiannual progress report, October 1983-March 1984.** McElroy, J.L.; Powell, J.A. (Pacific Northwest Lab., Richland, WA (USA)). Jun 1984. Contract AC06-76RL01830. 149p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE84017292.

Progress in the following studies on radioactive waste management is reported: defense waste technology; Nuclear Waste Materials Characterization Center; waste isolation; and supporting studies. 58 figures, 22 tables.

6495 **(PNL—4992) West Valley high-level nuclear waste glass development: a statistically designed mixture study.** Chick, L.A.; Bowen, W.M.; Lokken, R.O.; Wald, J.W.; Bunnell, L.R.; Strachan, D.M. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1984. Contract AC06-76RL01830. 201p. NTIS, PC A10/MF A01; GPO Dep. File Number DE85002570.

The first full-scale conversion of high-level commercial nuclear wastes to glass in the United States will be conducted at West Valley, New York, by West Valley Nuclear Services Company, Inc. (WVNS), for the US Department of Energy. Pacific Northwest Laboratory (PNL) is supporting WVNS in the design of the glass-making process and the chemical formulation of the glass. This report describes the statistically designed study performed by PNL to develop the glass composition recommended for use at West Valley. The recommended glass contains 28 wt% waste, as limited by process requirements. The waste loading and the silica content (45 wt%) are similar to those in previously developed waste glasses; however, the new formulation contains more calcium and less boron. A series of tests verified that the increased calcium results in improved chemical durability and does not adversely affect the other modeled properties. The optimization study assessed the effects of seven oxide components on glass properties. Over 100 melts combining the seven components into a wide variety of statistically chosen compositions were tested. Viscosity, electrical conductivity, thermal expansion, crystallinity, and chemical durability were measured and empirically modeled as a function of the glass composition. The mathematical models were then used to predict the optimum formulation. This glass was tested and adjusted to arrive at the final composition recommended for use at West Valley. 56 references, 49 figures, 18 tables.

6496 **(PNL—5044) Verification and benchmarking of PORFLO: an equivalent porous continuum code for repository scale analysis.** Eyler, L.L.; Budden, M.J. (Pacific Northwest Lab., Richland, WA (USA)). Nov 1984. Contract AC06-76RL01830. 184p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE85004116.

The objective of this work was to perform an assessment of prediction capabilities and features of the PORFLO code in relation to its intended use in the Basalt Waste Isolation Project. This objective was to be accomplished through a code verification and benchmarking task. Results were to be documented which either support correctness of prediction capabilities or identify areas of intended application in which the code exhibits weaknesses. A test problem set consisting of 10 problems was developed. Results of PORFLO simulations of these problems were provided for use in this work. The 10 problems were designed to test the three basic computational capabilities or categories of the code. Broken down by physical process, these are heat transfer, fluid flow, and radionuclide transport. Two verification problems were included within each of these categories. They were problems designed to test basic features of PORFLO for which analytical solutions are available for use as a known comparison basis. Hence they are referred to as verification problems. Of the remaining four problems, one repository scale problem representative of intended PORFLO use within BWIP was included in each of the three basic capabilities categories. The remaining problem was a case specifically designed to test features of decay and retardation in radionuclide transport. These four problems are referred to as benchmarking problems, because results computed with an additional computer code were used as a basis for comparison. 38 figures.

6497 **(PNL—5250) Impact testing of centrifugally cast canisters of simulated waste glass.** Peterson, M.E.; Alzheimer, J.M. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1984. Contract AC06-76RL01830. 36p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85003270.

Four simulated high-level waste canisters supplied by EG & G Idaho, Inc. of Idaho Falls, Idaho, were subjected to impact tests at the Pacific Northwest Laboratory in Richland, Washington. The canister design was similar to the most recent Savannah River Laboratory (SRL) reference dewsign for the Defense Waste Processing Facility. Three of the canister bodies were fabricated out of a special cast alloy (the centrifugally cast equivalent of 304L stainless steel). These were nonradioactive versions of canisters that can be fabricated by recycling slightly contaminated stainless steel. A canister of wrought 304L stainless steel was also tested as a control. The canisters were filled with a borosilicate glass at SRL. The purpose of the test was to evaluate the effect of impacts on the canisters and provide input for a study to determine if slightly contaminated metal could be used for waste disposal canisters. Each canister was subjected to three impacts. The first was a vertical drop from 30 ft onto an unyielding surface with the bottom corner of the canister receiving the impact. The second was a horizontal drop from 40 in. onto a solid steel vertical cylinder (6 in. dia x 14 in. long) in a puncture test. The final drop was from 30 ft onto an unyielding surface with the fill nozzle and head receiving the impact. No rupturing of any of the canisters occurred as a result of the impacts. Strain circles were used to measure the surface strain in the impact areas. The maximum tensile strain experienced was 13% and the maximum compressive strain experienced was 16%. These measured strains were below the minimum strain required for failure, which is at least 30%. A helium leak test and liquid dye penetrant test were conducted on the weld regions of these canisters after the drop to evaluate the condition of the canister. No leaks were detected and no significant indications of cracks appeared. 2 references, 39 figures.

6498 **(PNL—5254) Consolidation of simulated nuclear metallic waste by vacuum coreless induction melting.** Montgomery, D.R. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1984. Contract AC06-76RL01830. 39p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85003666.

Vacuum coreless induction melting with bottom pouring has exceeded expectations for simplicity, reliability, and versatility when melting the zirconium and iron eutectic alloy. The melting tests have established that: the eutectic mixture of oxidized Zircaloy 4 hulls mixed with Type 316 stainless steel hulls can be melted at 41 kg/h at 40 kW with a power consumption of 1.03 kWh/kg and a melting temperature of 1260°C; the life of a graphite crucible can be expected to be longer by a factor of 4 than was previously projected; the bottom-pour water-cooled copper freeze plug was 100% reliable; a 24-in.-tall stainless steel canister with 1/4-in.-thick walls (6-in. inside diameter) was satisfactory in every respect; an ingot formed from 4 consecutive heats poured into a stainless steel canister appeared to be ~ 99% dense after sectioning; preplaced scrap in the canister can be encapsulated with molten metal to about 99% density; large pieces of Zircaloy 4 and stainless steel scrap can be melted, but have differing melting parameters; the pouring nozzle requires further development to prevent solidified drops from forming at the hole exit after a pour. It is recommended that a large-scale cold mock-up facility be established to refine and test a full-scale vacuum coreless induction melting system. Other options might include further scaled-down experiments to test other alloys and crucible materials under different atmospheric conditions (i.e., air melting). 1 reference, 18 figures, 1 table.

6499 **(PNL-SA—12678) Cooling and devitrification in a canister of simulated nuclear waste glass.** Kuhn, W.L.; Ethridge, L.J. (Pacific Northwest Lab., Richland, WA (USA)). Aug 1984. Contract AC06-76RL01830. 14p. (CONF-841043—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003630.

From 37. Pacific Coast regional meeting of the American Ceramic Society; San Francisco, CA, USA (28 Oct 1984).

One objective of the West Valley Support Task is to develop and demonstrate means by which the Liquid-Fed Ceramic Melter (LFCM) process instrumentation and a knowledge of process phenomena can be used to control and assess the quality of the glass product. During March and May 1984, two runs on PNL's Pilot-Scale Ceramic Melter (PSCM), designated PSCM-14 and PSCM-15, were conducted to achieve a number of objectives. Among these were to fill two instrumented canisters, roughly representing typical West Valley canisters, and to assess the glass product and compare it with that expected from recorded process variables. The glass quality depends mainly on its composition and structure. Structure includes voids, devitrification, and cracking. The emphasis in the work to date has been on a quantitative determination of composition and devitrification. Qualitative information on voids is available upon removing the side from a filled can, and has shown for both PSCM-14 and PSCM-15 that glass adequately fills an uninsulated canister, but does so by flowing radially outward in a series of lobes as it pours onto the center of the rising glass surface. This held true for pour rates of 44 and 19 kg/h. No work has been done yet to measure the extent of cracking. The results of temperature measurements are presented. These are then used to assess our ability to predict canister temperatures (are they in agreement with heat transfer theory). A qualitative comparison of devitrification with the temperature histories is made in lieu of laboratory information on the devitrification rates, which is not yet available as a function of temperature for the interim glass composition that has been used for these runs. When a final West Valley glass composition is chosen, more detailed studies will become appropriate.

6500 **(REG/G—4.16-Rev.) Monitoring and reporting radioactivity in releases of radioactive materials in liquid and gaseous effluents from nuclear fuel processing and fabrication plants and uranium hexafluoride production plants.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research). Sep 1984. 21p. NTIS, PC A02/MF A01 - GPO*. File Number TI85900262.

This guide provides methods acceptable to the Nuclear Regulatory Commission staff for developing effluent monitoring programs to be described in license applications and for monitoring and reporting effluent data by licensees. The guidance is applicable to nuclear fuel processing and fabrication plants and uranium hexafluoride production plants.

6501 **(RFP—3680) Remote-handled/special case TRU waste characterization summary.** Detamore, J.A. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 30 Mar 1984. Contract AC04-76DP03533. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85002972.

TRU wastes are those (other than high level waste) contaminated with specified quantities of certain alpha-emitting radionuclides of long half-life and high specific radiotoxicity. TRU waste is defined as $^{226}Ra$ isotopic sources and those other materials that, without regard to source or form, are contaminated with transuranic elements with half-lives greater than 20 years, and have TRU alpha contamination greater than 100 nCi/g. RH TRU waste has high beta and gamma radiation levels, up to 30,000 R/hr, and thermal output may be a few hundred watts per container. The radiation levels in most of this remotely handled (RH) TRU waste, however, are below 100 R/hr. Remote-handled wastes are stored at Los Alamos, Hanford, Oak Ridge, and the Idaho National Engineering Laboratory. This report presents a site by site discussion of RH waste handling, placement, and container data. This is followed by a series of data tables that were compiled in the TRU Waste Systems Office. These tables are a compendium of data that are the most up to date and accurate data available today. 10 tables.

6502 **(SAND—83-1778) Repository sealing concepts for the Nevada nuclear waste storage Investigations Project.** Fernandez, J.A.; Freshley, M.D. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1984. Contract AC04-76DP00789. 91p. NTIS, PC A05/MF A01; GPO Dep. File Number DE85003480.

This report describes concepts for sealing a nuclear waste repository in an unsaturated tuff environment. The repository site under consideration is Yucca Mountain, which is on and adjacent to the Nevada Test Site. The hydrogeology of Yucca Mountain, preliminary repository concepts, functional requirements and performance criteria for sealing, federal and state regulations, and hydrological calculations are considered in developing the sealing concepts. Water flow through the unsaturated zone is expected to be small and generally vertically downward with some potential to occur through discrete fault and fracture zones. These assumptions are used in developing sealing concepts for shafts, ramps, and boreholes. Sealing of discrete, water-producing faults and fracture zones encountered in horizontal emplacement holes and in access and emplacement drifts is also described. 49 references, 21 figures, 6 tables.

6503 **(SAND—83-7443) Evaluation of the effects of horizontal and vertical emplacement on mining at the Yucca Mountain repository site.** (Dravo Engineers, Inc., Denver, CO (USA)). Oct 1984. Contract AC04-76DP00789. 96p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85003477.

This study was conducted between January 1983 and July 1983 and used assumptions and criteria available at that time. Subsequent data and criteria may supersede those used and may produce different results. The study evaluates the effects of two methods of waste canister emplacement on mining at the proposed nuclear waste repository in tuff. The two methods are the emplacement of waste canisters in vertical boreholes drilled in the drift floor and the emplacement of waste canisters in horizontal boreholes drilled in drift walls. This study considered several mine configurations for each emplacement method before one configuration for each method was selected as technically advantageous. Ventilation plans for each of the two configurations were also developed. The total mine cost for each method was estimated based on calculated manpower requirements, ventilation, and shaft and slope costs. In general, the horizontal emplacement method is considered superior to the vertical emplacement method in terms of lower costs, lower extraction ratio, and lower manpower requirements. Further study of multiple vertical canister emplacement, fracture orientation at the site, the type of mine opening cross section most suitable for the area, and ventilation requirements after emplacement is completed is recommended. 4 references, 8 figures, 12 tables.

6504 **(SAND—84-7103) Small diameter horizontal hole drilling - state of technology.** (Robbins Co., Kent, WA (USA)). Nov 1984. Contract AC04-76DP00789. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85004389.

The purpose of this study is to determine the existing state of the art for small diameter, horizontal pilot hole drilling. The data were collected by contacting worldwide owners of raise or slant hole drill equipment, manufacturers of drills and bits, and manufacturers of survey tools. The study was limited to existing equipment and completed trials. Most attempts at directional pilot hole drilling, and most survey tools are designed for near vertical, downward drilling. Several types of controllable bits are available which depend upon in-hole motors and bent or wedged assemblies to bias the direction of drilling. Accurate horizontal drilling can be achieved in this way by alternately drilling and surveying at frequent intervals. This procedure is impractical, however, from both a production and a cost standpoint. A few attempts at directional drilling have been made using ordinary drilling tools, a rotary drill string and a tricone bit. Good equipment and a well trained drill crew appeared to be the most significant factor in practical, accurate drilling, whether horizontal or vertical. Because of the cost, no one uses steerable bit drilling except for correction, and then only for short portions of an overall drill program. No satisfactory continuous readout surveying tool, coupled with a remotely controlled bit capable of direction correction, exists. An industry need exists for a high speed, directional drill bit, coupled with a continuously monitored survey tool. 2 tables.

6505 **(SAND—84-7201) Nevada Nuclear Waste Storage Investigations: socioeconomic impacts of constructing a high-level waste repository at Yucca Mountain.** McBrien, S.; Jones, L. (Mitre Corp., McLean, VA (USA). METREK Div.). Dec 1984. Contract AC04-76DP00789. 205p. NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE85004357.

This document presents a preliminary cost analysis and potential socio-economic impacts associated with construction, operation, and decommissioning of a high-level nuclear waste repository under Yucca Mountain in southern Nevada. Specifically, this report addresses potential changes in demographic, social services, and economic growth patterns in southern Nevada which might be attributed to the repository work force. The document contains detailed appendices with information on the existing demographic, economic and other infrastructure components of the southern Nevada region. Data in these appendices were used to complete the analysis in the body of the report. These data also could be used to conduct future socio-economic analyses of the region. 4 references, 6 figures, 21 tables.

6506 **(USGS-OFR—84-449) Geohydrologic and drill-hole data for test well USW H-4, Yucca Mountain, Nye County, Nevada.** Whitfield, M.S. Jr.; Thordarson, W.; Eshom, E.P. (Geological Survey, Denver, CO (USA)). 1984. Contract AI08-78ET44802. 44p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85003219.

This report presents data on drilling operations, lithology, geophysical well logs, sidewall-core samples, water-level monitoring, pumping tests, injection tests, radioactive-tracer borehole flow survey, and water chemistry for test well USW H-4. The well is one of a series of test wells drilled in the southwestern part of the Nevada Test Site, Nye County, Nevada, in cooperation with the US Department of Energy. These test wells are part of the Nevada Nuclear Waste Storage Investigations to identify sites for storage of high-level radioactive wastes. Test well USW H-4 was drilled in ash-flow tuff to a total depth of 1219 meters. Depth to water below land surface was 519 meters, or at an altitude of 730 meters above sea level. After test pumping at a rate of 17.4 liters per second for approximately 9 days, the drawdown was 4.85 meters. A radioactive borehole-flow survey indicated that the Bullfrog Member of the Crater Flat Tuff (Tertiary age) was the most productive geologic unit, producing 36.5 percent of the water in the well. The second most productive geologic unit was the Tram Member of the Crater Flat Tuff, which produced 32 percent of the water. The water in test well USW H-4 is predominantly a soft, sodium bicarbonate type of water typical of water produced in tuffaceous rocks in southern Nevada. 7 references, 26 figures, 9 tables.

6507 **(USGS-OFR—84-552) Rock property measurements on large-volume core samples from Yucca Mountain USW GU-3/G-3 and USW G-4 boreholes, Nevada Test Site, Nevada.** Anderson, L.A. (Geological Survey, Denver, CO (USA)). 1984. Contract AI08-78ET44802. 43p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85004567.

Core samples were selected at the drill site so as to be representative of the major lithologic variations observed within the principal stratigraphic units. Upon removal from the borehole, the cores were washed free of drilling mud, labeled as to depth and vertical attitude, wrapped in aluminum foil, and coated with beeswax in an effort to minimize the loss of natural pore water during the period prior to rock property analysis. Following delivery to the Denver laboratories of the USGS, the samples were measured for electrical resistivity, induced polarization, porosity, bulk and grain density, and compressional sonic velocity. The results of the measurements are intended for use in the interpretation of inhole and surface geophysical surveys as well as to provide a means for rock property characterization that is not normally possible with conventional borehole techniques. 7 references, 12 figures, 4 tables.

6508 **(USGS-OFR—84-672) Borehole gravity meter surveys in drill holes USW G-3, UE-25p No. 1 and UE-25c No. 1, Yucca Mountain Area, Nevada.** Healey, D.L.; Clutsom, F.G.; Glover, D.A. (Geological Survey, Denver, CO (USA)). 1984. Contract AI08-78ET44802. 25p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004344.

The borehole gravity meter (BHGM) measures a larger volume of rock than conventional logging tools and provides an independent measurement of the in situ bulk density. Drill holes USW G-3, UE-25p No. 1, and UE-25c No. 1 were logged with the BHGM and free-air gradient (FAG) measurements were made at UE-25p No. 1 and UE-25c No. 1. The BHGM data in these two holes were reduced using the measured FAG values. Windy conditions prevented measuring a FAG at USW G-3 and these data were reduced using the assumed normal value of 0.3086 mGal/m. At UE-25p No. 1 and UE-25c No. 1, respectively, the measured FAG values are 1.8 and 0.97% higher and the calculated densities are 0.07 and 0.04 $mg/m^3$ higher than values calculated using the normal value. These calculated differences in density are not insignificant and indicate the need to measure the FAG at each logged hole. The interval densities calculated from the three BHGM surveys are presented herein. 7 references, 4 figures, 7 tables.

6509 **Uranium mill tailings management: cover systems, containment migration and long-term stability.** Hartley, J.N.; Fluey, M.G.; Gee, G.W. (Pacific Northwest Laboratory, Richland, Washington). *Preprint, Society of Mining Engineers of AIME;* **84-50**: 14(Feb 1984). (CONF-840218—).

From 113. annual meeting of the American Institute of Mining, Metallurgical and Petroleum Engineers; Los Angeles, CA, USA (26 Feb 1984).

Uranium mill tailings, waste products of uranium extraction, contain hazardous constituents that if released into the atmosphere and groundwater could threaten our health and environment. To provide for safe disposal and control of these tailings, Congress enacted the Uranium Mill Tailings Radiation Control Act of 1978 (Public Law 95-604). Subsequently, the Environmental Protection Agency (EPA) established standards for tailings disposal that limit radon emission into the air to 20 pCi $m^{-2}s^{-1}$ on an annual average basis (EPA 1983). The design life of the impoundment is to be 1000 years where practicable, but 200 years at least. To facilitate the design of containment systems that will meet the EPA standards, the Nuclear Regulatory Commission (NRC) and the Department of Energy (DOE) are sponsoring research at the Pacific Northwest Laboratory (PNL) to develop the necessary technology. Earthen and asphalt materials have been evaluated for use as radon barriers (Hartley 1983) and as liners to minimize leaching (Buelt 1983). Herbicide and rock barriers against biological intrusion have been evaluated (Cline 1982). Surface stabilization techniques have been investigated to maintain the long-term effectiveness of a containment system that must be protected from wind and water erosion, chemical and physical degradation, and biological disturbance. This paper summarizes the research on uranium mill tailings management, including cover systems, liners, and long-term stabilization.

6510 **Selected metal recovery in pitchblende residue disposal.** Hofman, L.A. (Bechtel National Inc., Oak Ridge, TN). pp 60-61 of Shaping our energy future. Knoxville, TN, USA; LTM Consultants (1984). (CONF-840229—).

From 11. annual WATTec conference and exposition - shaping our energy future; Knoxville, TN, USA (21 Feb 1984).

Abstract only.

An investigation was conducted to evaluate a method for resource recovery and waste immobilization for pitchblende residues within the U.S. Department of Energy (DOE) waste inventory. These residues resulted from uranium extraction of African ores in the 1940s in support of the war effort. They are temporarily in storage in New York and Fernald at DOE controlled sites. These residues are richer in radium than those of U.S.-extracted ores because of their high uranium content (35-60% $U_3O_8$). They are highly dispersive. The residues contain appreciable concentrations of precious metals and uranium. A disposal method selected for these residues should address the potential for migration into air and water. In addition, disposal should not waste limited resources which have some utility. A process for resource recovery and waste immobilization was developed which would minimize long-term risk of the residues in the environment, reduce maintenance costs for storage and minimize disposal costs. The process involves three steps: carbonate leach, yellowcake formation, and electric furnace smelting. The initial two steps result in uranium recovery. The smelting results in the recovery of precious and base metals and fuses the radium-bearing slag into a nondispersive waste form.

6511 **Performance assessment of nuclear waste isolation systems.** Lee, W.L. (Roy F. Weston Engineering Co., Rockville, MD). pp 59 of Shaping our energy future. Knoxville, TN, USA; LTM Consultants (1984). (CONF-840229—).

From 11. annual WATTec conference and exposition - shaping our energy future; Knoxville, TN, USA (21 Feb 1984).

Abstract only.

A number of concepts have been proposed for the isolation of highly radioactive wastes, and it will be necessary to demonstrate the safety of such systems. In many countries including the U.S., the waste isolation system of choice is deep mined geologic repositories. Because of the complex nature of the multiple isolation barriers afforded by mined geologic disposal systems, and the long isolation periods involved, this demonstration can only be indirect. In recent years this indirect demonstration, mostly through mathematical modeling, is called performance assessment. Performance Assessment can be defined to mean the development, testing, and application of a series of mathematical models and computer codes which traces the movement of radionuclides from a waste isolation system to the biosphere and any resultant dose to man. In modeling such a repository system, it is often convenient to divide it into a number of subsystems, there may be several different processes that need to be modeled, individually and interactively. For instance, this waste package will probably consist of a waste form such as borosilicate glass containing the radioisotopes, a canister, an overpack material such as steel or copper, and a buffer material such as bentonite. The processes to be modeled at the waste package scale include radioisotope inventory and decay, thermal radiation, radiolysis effects, corrosion, leading and fluid flow. In tracing radionuclide transport through rock, the processes of importance are probably groundwater flow, and sorption and retardation of radionuclide movement.

6512 **Remediation of contaminated sites resulting from ore extraction and refining.** White, M.G. (Department of Energy, Washington, DC). pp 60 of Shaping our energy future. Knoxville, TN, USA; LTM Consultants (1984). (CONF-840229—).

From 11. annual WATTec conference and exposition - shaping our energy future; Knoxville, TN, USA (21 Feb 1984).

Abstract only.

The Technical Measurements Center of the Department of Energy's Remedial Action Projects was established in 1982 to bring about a consolidated approach to various measurement programs. The applications of these activities to remedial action programs are multiple and assure the quality of the actions taken to decontaminate and release or manage specific sites. One factor is paramount in the environmental measurements performed to support remedial

action activities. That is the calibration of measurement systems. These measurements determine the need and the extent of remedial actions at these sites and therefore greatly affect expenditure of taxpayer monies. No two contractors calibrate instrumentation using the same techniques, similar physical standards, or duplicate controls. It becomes very important for the DOE to fund programs to formally document investigation, evaluation, and recommendations of measurement methods. In this way the most reliable methods can be documented and are then available for use at a variety of mill tailings and extraction process plants. Other factors are also important to the establishment of a high quality measurements program in order to assist in decision-making for guidance in design and implementation of remedial actions. These include clear definition of decontamination and release standards, and clear integration of all program elements from investigation through remediation since these elements are performed by a sequence of contractors.

6513 **Scientific basis for nuclear waste management VII.** McVay, G.L. (ed.). New York, NY; Elsevier Science Publishing Company, Inc. (1984). 1096p. (CONF-831174—). Elsevier Science Publishing Co., 52 Vanderbilt Ave., New York, NY 10017. File Number TI84014304.

From Materials Research Society annual meeting; Boston, MA, USA (14 Nov 1983).

This symposium addressed geomedia-specific research relating to repository placement and licensing. The following sessions were held: salt (Europe, WIPP); basalt; granite; tuff; salt (Texas/Utah/Mississippi); waste form development and characterization; leaching and waste package investigations; repository and far-field related investigations; and modeling. Individual papers were processed for inclusion in the Energy Data Base.

6514 **Effect of iron on waste-glass leaching.** McVay, G.L.; Buckwalter, C.Q. (Battelle Pacific Northwest Labs., Richland, WA). *Journal of the American Ceramic Society;* **66**: No. 3, 170-174(Mar 1983). Contract AC06-76RL01830.

The interactive effects between ductile iron and PNL 76-68 borosilicate glass were investigated as a function of time in 90°C static deionized, tuff, and basalt groundwaters. A synergistic effect occurs between the two materials, i.e. iron enhances glass dissolution and glass enhances iron corrosion. An iron silicate precipitate forms, part of which is colloidal in nature. This precipitate effectively removes many of the elements from solution and therefore inhibits the saturation effects which normally cause decreases in elemental removal rates. Thus, the effects of initial solution composition on the glass leach rates are significantly reduced and the relatively high early leach rates normally observed in deionized water are maintained for longer times due to the suppression of saturation effects. This results in more total elemental removal from the glass in all of the groundwaters evaluated. The precipitate and its colloidal form require further characterization.

6515 **(DP-tr—70-84) Tritium enrichment by isotope exchange between hydrogen and water using a hydrophobic catalyst for the nuclear fuel reprocessing.** Fiek, H.J.; Romaker, J.; Schindewolf, U. Translated from *Chemie-Ingenieur-Technik ;* **52**: No. 11, 892-895(1980). Contract AC09-76SR00001. 9p. NTIS, PC A02/MF A01; GPO Dep. File Number DE84017505. DE84017505

The title process can be conducted by using catalysts which have been impregnated with silane, PTFE, and other materials to render them hydrophobic. Thus the active centers are prevented from being blocked by $H_2O$, and exchange at the catalyst can, therefore, in principle, occur between H and water vapor. For example, a catalyst is described having Pt, active carbon, and PTFE as components, in Raschig-ring form. During the nuclear fuel reprocessing tritium, which forms through multiple fission of the nuclear fuel, is partially transferred into the aqueous process streams, from the waste stream of which it must be extracted to safely deposit it in a minimum amount of space, if the waste streams cannot be injected into the earth. For the extraction all those processes are, in principle, suitable, which were also developed for the extraction of the deuterium during the heavy water production. According to our estimations, the most economical and at the same time the safest process might be a combination of the water electrolysis with the isotope exchange between hydrogen and water $HT + H_2O$ in equilibrium $H_2 + HTO$ using a fixed bed catalyst. This process can be carried out at normal pressure (important because of tritium leakage), insofar as a catalyst is available which has a high activity and does not lose it even in the presence of liquid water. Recently many reports appeared in the literature concerning such catalysts, which are rendered hydrophobic by impregnating them with silanes, PTFE, and other materials, such that a blocking of the active centers by water is prevented, and thus the exchange at the catalyst must, in principle, occur between the hydrogen and water vapor.

## 0530 Environmental Aspects

*REFER ALSO TO CITATION(S) 0530006464, 6487, 6492, 6496, 6511, 6513, 6526, 6527, 6528, 6533, 7243, 7383, 7413, 7546, 7555*

6516 **(CONF-8409115—14) Groundwater suppression and surface water diversion structures applied to closed shallow land burial trenches.** Davis, E.C.; Stansfield, R.G.; Melroy, L.A.; Huff, D.D. (Oak Ridge National Lab., TN (USA)). 1984. Contract AC05-84OR21400. 12p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85003544.

From 6. annual Low-Level Waste Management Program participants' information meeting; Denver, CO, USA (11 Sep 1984).

Shallow depth to groundwater, surface drainage, and subsurface flow during storm events are major environmental concerns of low-level radioactive waste management operations in humid regions. At two waste disposal sites within the Oak Ridge National Laboratory (ORNL), groups of closed trenches have experienced these problems and have been shown to collect and hold water with seasonal fluctuations ranging from 1 to 2 m. In an attempt to correct these water-related problems, the older of the two sites [Solid Waste Storage Area Four (SWSA 4)] was equipped in September 1975 with asphalt lined drainage-ways designed to prevent infiltration of storm drainage from a 13.8-ha upslope catchment. At the second site (49-Trench area of SWSA 6), the entire 0.44-ha trench area was capped with a bentonite clay cover in 1976. These attempts have not corrected the water problems. In September 1983, engineered drainage projects were initiated at both the disposal sites. The SWSA 4 project was designed to divert surface runoff and shallow subsurface flow which originates upslope of the site away from the disposal area. The second project, a passive French drain constructed in SWSA 6, was aimed strictly at suppressing the site water table, thus preventing its intersection with the bottoms of disposal trenches. Postconstruction monitoring for performance evaluation has shown that the water table in the 49-Trench area has been suppressed to a depth $> 4.9$ m below the ground surface over 50% of the site as compared to a depth of only 2.1 m for certain parts of the same area observed during seasonally wet months prior to drain construction. The SWSA 4 project evaluation indicates that 56% of the Winter-Spring 1984 runoff was diverted around SWSA 4 via the drainage system.

6517 **(DP-MS--84-125) Development and implementation of a comprehensive groundwater protection program at the Savannah River Plant.** Gordon, D.E. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1984. Contract AC09-76SR00001. 22p. (CONF-841187—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85002827.

From 5. DOE environmental protection information meeting; Albuquerque, NM, USA (6 Nov 1984).

The major goals of the groundwater protection program are to evaluate the impact on groundwater quality as a result of Savannah River Plant operations, to take corrective measures as required to restore or protect groundwater quality, and to ensure that future operations do not adversely affect the quality or availability of the groundwater resources at the site. The specific elements of this program include (1) continuation of an extensive groundwater monitoring program, (2) assessment of waste disposal sites for impacts on groundwater quality, (3) implementation of mitigative actions, as required, to restore or protect groundwater quality, (4) incorporation of groundwater protection concepts in the design of new production and waste management facilities, and (5) review of site utilization of groundwater resources to ensure compatibility with regional needs. The major focal points of the groundwater protection pro-

gram are the assessment of waste disposal sites for impacts on groundwater quality and the implementation of remedial action projects. Many locations at SRP have been used as waste disposal sites for a variety of liquid and solid wastes. Field investigations are ongoing to determine the nature and extent of any contamination in the sediments and groundwater at these waste sites on a priority basis. Remedial action has been initiated. Certain aspects of the groundwater protection program have been identified as key to the success in achieving the desired objectives. Key elements of the program have included early identification of all the potential sources for groundwater contamination, development of an overall strategy for waste site assessment and mitigation, use of a flexible computerized system for data base management, and establishing good relationships with regulatory agencies. 10 references, 6 figures, 4 tables.

6518 **(LBL—18250) Panel report on coupled thermo-mechanical-hydro-chemical processes associated with a nuclear waste repository.** Tsang, C.F.; Mangold, D.C. (eds.). (Lawrence Berkeley Lab., CA (USA)). Jul 1984. Contract AC03-76SF00098. 89p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85004340.

Four basic physical processes, thermal, hydrological, mechanical and chemical, are likely to occur in 11 different types of coupling during the service life of an underground nuclear waste repository. A great number of coupled processes with various degrees of importance for geological repositories were identified and arranged into these 11 types. A qualitative description of these processes and a tentative evaluation of their significance and the degree of uncertainty in prediction is given. Suggestions for methods of investigation generally include, besides theoretical work, laboratory and large scale field testing. Great efforts of a multidisciplinary nature are needed to elucidate details of several coupled processes under different temperature conditions in different geological formations. It was suggested that by limiting the maximum temperature to 100°C in the backfill and in the host rock during the whole service life of the repository the uncertainties in prediction of long-term repository behavior might be considerably reduced.

6519 **(NUREG/CR—3985) Organic complexant-enhanced mobility of toxic elements in low-level wastes. Annual report, July 1983-June 1984.** Swanson, J.L. (Pacific Northwest Lab., Richland, WA (USA)). Nov 1984. Contract AC06-76RL01830. 54p. (PNL—4965-4). NTIS, PC A04/MF A01 - GPO $4.25. File Number TI85002880.

This report describes the initial results obtained in a project whose objective is to determine how and to what extent organic complexants affect the mobility of toxic elements in subsurface groundwaters at commercial low-level waste disposal sites. Generic soil components (e.g., hydrous oxides, silica, clays) are being employed so that the results will be broadly applicable. Organic complexants used in the nuclear industry are being emphasized. Data have been obtained with two radioactive ($^{63}$Ni and $^{239}$Pu) and one nonradioactive toxic element (Cd). Work with $^{63}$Ni has been emphasized; it was studied with five different generic soil components (hydrous ferric oxide, silica, titania, kaolinite, and montmorillonite) and five different complexants (EDTA, NTA, picolinate, citrate, and oxalate). EDTA was the complexant studied most extensively and hydrous ferric oxide was the most studied soil component. A wide diversity of effects of organic complexants on toxic elements sorption was observed. The effects vary not only among complexants, but also among toxic elements and among soil components. In some systems the complexant results in increased toxic element sorption (decreased mobility) while in other systems the complexant results in decreased toxic element sorption (increased mobility). 16 references, 14 figures, 5 tables.

6520 **(ORNL—6083) Geochemical information for sites contaminated with low-level radioactive wastes: I. Niagara Falls Storage Site.** Seeley, F.G.; Kelmers, A.D. (Oak Ridge National Lab., TN (USA)). Nov 1984. Contract AC05-84OR21400. 123p. NTIS, PC A06/MF A01; GPO Dep. File Number DE85003718.

The Niagara Falls Storage Site (NFSS) became radioactively contaminated as a result of wastes that were being stored from operations carried out to recover uranium from pitchblende ore in the 1940s and 1950s. The US Department of Energy (DOE) is considering various remedial action options for the NFSS. This report describes the results of geochemical investigations performed to help provide a quantitative evaluation of the effects of various options. NFSS soil and groundwater samples were characterized; and uranium and radium sorption ratios, as well as apparent concentration limit values, were measured in site soil/groundwater systems by employing batch contact methodology. The results suggest that any uranium which is in solution in the groundwater at the NFSS may be poorly retarded due to the low uranium sorption ratio values and high solubility measured. Further, appreciable concentrations of uranium in groundwater could be attained from soluble wastes. Release of uranium via groundwater migration could be a significant release pathway. Solubilized radium would be expected to be effectively retarded by soil at the NFSS as a result of the very high radium sorption ratios observed. The addition of iron oxyhydroxide to NFSS soils resulted in much higher uranium sorption ratios. Additional field testing of this potential remedial action additive could be desirable. 10 references.

6521 **(PNL—5253) Field lysimeter facility for evaluating the performance of commercial solidified low-level waste.** Walter, M.B.; Graham, M.J.; Gee, G.W. (Pacific Northwest Lab., Richland, WA (USA)). Nov 1984. Contract AC06-76RL01830. 46p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85003886.

Analyzing the potential migration of radionuclides from sites containing solid low-level wastes requires knowledge of contaminant concentrations in the soil solution surrounding the waste. This soil solution concentration is generally referred to as the source term and is determined by such factors as the concentration of radionuclides in the solid waste, the rate of leachate formation, the concentration of dissolved species in the leachate, any solubility reactions occurring when the leachate contacts the soil, and the rate of water flow in the soil surrounding the waste. A field lysimeter facility established at the Hanford site is being used to determine typical source terms in arid climates for commercial low-level wastes solidifed with cement, Dow polymer (vinyl ester-styrene), and bitumen. The field lysimeter facility consists of 10, 3-m-deep by 1.8-m-dia closed-bottom lysimeters situated around a 4-m-deep by 4-m-dia central instrument caisson. Commercial cement and Dow polymer waste samples were removed from 210-L drums and placed in 8 of the lysimeters. Two bitumen samples are planned to be emplaced in the facility's remaining 2 lysimeters during 1984. The central caisson provides access to the instrumentation in the individual lysimeters and allows selective sampling of the soil and waste. Suction candles (ceramic cups) placed around the waste forms will be used to periodically collect soil-water samples for chemical analysis. Meteorological data, soil moisture content, and soil temperature are automatically monitored at the facility. Characterization of the soils and waste forms have been partially completed. These data consist of moisture release characteristics, particle-size distribution, and distributions and concentrations of radionuclides in the waste forms. 11 references, 12 figures, 5 tables.

6522 **(PNL-SA—12369) $^{237}$Np and $^{239}$Pu solution behavior during hydrothermal testing of simulated nuclear waste glass with basalt and steel.** Schramke, J.A.; Simonson, S.A.; Coles, D.G. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1984. Contract AC06-76RL01830. 9p. (CONF-841157—21). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003642.

From Symposium on the scientific basis for nuclear waste management; Boston, MA, USA (26 Nov 1984).

A series of hydrothermal experiments were carried out on $^{237}$Np- and $^{239}$Pu-doped PNL 76-68 glass, synthetic basalt groundwater, basalt, and cast steel. Experiments of duration were conducted in Dickson-type rocking autoclaves at 200°C and 30 MPa, with an initial fluid to solid weight ratio of 10:1. The tests carried out were: glass and groundwater; glass, basalt, and groundwater; glass, steel, and groundwater; and glass, steel, basalt, and groundwater. Unfiltered, 4000 A filtered, and 18 A filtered solutions were analyzed to determine the concentrations of radionuclides in solution and those associated with colloids. In all four experiments, $^{237}$Np and $^{239}$Pu were present in solution in quantities at or below the analytical detection limits. The only detectable differences in radionu-

clide concentrations between the four experiments were brought about by changes in the amounts of colloidally associated radionuclides. Besalt added to the glass and groundwater system increased the quantities of the colloidally associated $^{237}Np$ and $^{239}Pu$ by an order of magnitude. The addition of steel to the glass and groundwater system reduced the colloidally associated radionuclides to levels below detection limits. The effects of both steel and basalt on the glass and groundwater system seemed to cancel out, and the colloidally associated radionuclide concentrations were similar to the observed levels in the glass plus groundwater system. These variations in the quantities of the colloidally associated radionuclides did not appear to be correlated with other changes in the quantities or composition of the colloidal material in solution. Other than $^{237}Np$ and $^{239}Pu$, silica was the only constituent of the colloids in these experiments. The amounts of colloidal silica did not vary significantly between the four experiments. 7 references, 7 figures.

**6523 (PNL-SA—12501) Trees as indicators of subterranean migration of tritium at a commercial shallow land radioactive waste disposal site.** Rickard, W.H.; Kirby, L.J. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1984. Contract AC06-76RL01830. 12p. (CONF-8409115—17). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003640.

From 6. annual Low-Level Waste Management Program participants' information meeting; Denver, CO, USA (11 Sep 1984).

Leaf water and tree sap collected from deciduous trees in a natural forest growing outside the fenced exclusion area of the Maxey Flats Waste Disposal Facility in eastern Kentucky, USA were radiochemically analyzed to detect movement of tritium via subterranean flows of water at depths of three meters. These data indicate that trees can be used to detect the subterranean migration of tritium from shallow land burial sites. 4 references, 5 figures, 1 table.

**6524 (PNL-SA—12512) Double sampling as a cost-effective method to estimate mean or total amounts of radioactivity.** Thomas, J.M.; Eberhardt, L.L.; Simmons, M.A. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1984. Contract AC06-76RL01830. 11p. (CONF-8409115—13). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003113.

From 6. annual Low-Level Waste Management Program participants' information meeting; Denver, CO, USA (11 Sep 1984).

In many field studies to determine the quantities of radioactivity at commercial low-level radioactive waste sites, preliminary appraisals are made with field radiation detectors, or other relatively inaccurate devices. More accurate determinations are subsequently made with procedures requiring chemical separations or other expensive analyses. Costs of these laboratory determinations are often large, so that adequate sampling may not be achieved due to budget limitations. In this paper we propose double sampling as a way to combine the expensive and inexpensive approaches to substantially reduce overall costs. The underlying theory was developed for human and agricultural surveys, and is partially based on assumptions that are not appropriate for commercial low-level waste sites. Consequently, extensive computer simulations must be conducted to determine whether the results can be applied in circumstances of importance to the Nuclear Regulatory Commission. Our initial simulation results lead us to believe that double sampling may be useful for some surveys at commercial low-level waste sites. Additional simulations are currently being evaluated using additional models and the range of parameters values likely to be encountered in field studies. 3 references, 2 tables.

## 0540 Health And Safety

*REFER ALSO TO CITATION(S) 0540006355, 6485, 7243*

**6525 (BMI/ONWI—551) Repository preclosure accident scenarios.** Yook, H.R.; Arbital, J.G.; Keeton, J.M.; Mosier, J.E.; Weaver, B.S. (Science Applications, Inc., Oak Ridge, TN (USA)). Sep 1984. Contract AC02-83CH10140. 375p. NTIS, PC A16/MF A01; 1; GPO Dep. File Number DE85003096.

Waste-handling operations at a spent-fuel repository were investigated to identify operational accidents that could occur. The facility was subdivided, through systems engineering procedures, into individual operations that involve the waste and one specific component of the waste package, in one specific area of the handling facility. From this subdivision approximately 600 potential accidents involving waste package components were identified and then discussed. Supporting descriptive data included for each accident scenario are distance of drop, speed of collision, weight of package component, and weight of equipment involved. The energy of impact associated with each potential accident is calculated to provide a basis for comparison of the relative severities of all the accidents. The results and conclusions suggest approaches to accident consequence mitigation through waste package and facility design. 35 figures, 9 tables.

**6526 (DOE/EV—0005/39-Suppl.1) Formerly utilized MED/AEC sites remedial action program. Geohydrological and radiological survey of the Albany Research Center, United States Bureau of Mines, Albany, Oregon, July 1983. Supplement 1.** Wynveen, R.A.; Smith, W.H.; Sholeen, C.M.; Justus, A.L.; Flynn, K.F.; Tsai, S.Y. (Argonne National Lab., IL (USA)). Jun 1984. Contract W-31-109-ENG-38. 117p. (ANL-OHS/HP—84-103). NTIS, PC A 06/MF A01; 1; GPO Dep. File Number DE85001415.

The purpose of this report is to present details of follow-up investigations of certain conditions revealed by the results of the initial survey - specifically the potential for contamination of groundwater and for lateral subsurface migration of radioactive waste from contaminated areas on the Albany Research Center site. 9 references, 12 figures, 7 tables.

**6527 (DOE/EV—0005/48) Formerly utilized MED/AEC sites remedial action program. Radiological survey of the Harshaw Chemical Company, Cleveland, Ohio.** Wynveen, R.A.; Smith, W.H.; Sholeen, C.M.; Justus, A.L.; Flynn, K.F. (Argonne National Lab., IL (USA)). Apr 1984. Contract W-31-109-ENG-38. 142p. (ANL-OHS/HP—84-104). NTIS, PC A07/MF A01; GPO Dep. File Number DE85001420.

During the MED/AEC era, the Harshaw Chemical Company processed large quantities of normal uranium to produce both oxide and fluoride compounds. This work was done under contract to MED and its successor, AEC. Records indicated that at the time the AEC contract was terminated, the facility was decontaminated by Harshaw and released from AEC control in 1960. However, a search of AEC records indicated that documentation was insufficient to determine whether the decontamination work was adequate by current guidelines. Hence, a radiological assessment of the site ws initiated in 1976. The entire grounds and all buildings were surveyed using surface survey instruments to detect surface contamination and radiation detectors to determine general radiation levels. Extensive surface contamination was found throughout the site. While the major contamination was found in Plant C, significant levels of contamination also were found in 16 other buildings and at 32 exterior locations. The contaminating material seemed to be normal uranium exclusively. Air samples were taken at numerous indoor locations throughout the site, but no elevated levels of radon were detected. This was as expected since normal uranium has been separated from radium and hence radon levels are very low. Several soil samples were taken from around the site. Analyses of these samples indicated extensive soil contamination, as well as suspected contamination of the river bed in the vicinity of the plant outfall. Scheduled subsurface investigation of the site, as well as of the river bed and sewer system, have not been conducted. Levels of contamination at this site are significantly above guidelines for release of the site for unrestricted use. 57 figures, 7 tables.

**6528 (INIS-mf—9079) Submission to the Royal Commission on Health and Environmental Protection - Uranium Mining. Phase VII: public and worker health.** Seguin, H. (United Steelworkers of America, Elliot Lake, Ontario (Canada)). (British Columbia Federation of Labour, Burnaby (Canada)). Jan 1980. 56p. NTIS (US Sales Only), PC A04/MF A01. File Number DE85780134.

This submission is intended to provide a brief resume of Elliot Lake's uranium mining/milling history, particularly with respect to the adverse effects on workers' health and the environment

in general. Elliot Lake has pioneered various uranium mining and processing techniques. Its operations have also been directly linked with death and incapacities of workers and considerable destruction of the surrounding environment. The union believes that many unknowns continue to exist and that considerable research is required before various answers are available. It is for these reasons that the union approaches uranium mining expansion and new developments with extreme caution.

6529 **(MLM—3218(OP)) Outdoor radon monitoring at DOE remedial action sites.** Rudy, C.R.; Jenkins, P.H.; Hagee, G.R.; Hall, J.B.; Jarvis, J.Y. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 7 Nov 1984. Contract AC04-76DP00053. 15p. (CONF-841187—10). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003305.

From 5. DOE environmental protection information meeting; Albuquerque, NM, USA (6 Nov 1984).

The Mound Radon Program has performed extensive outdoor radon monitoring near six remedial action sites for the Department of Energy since 1980. The results of these environmental measurements indicate that yearly average background concentrations as low as 0.1 to 0.2 picocuries/liter can be determined using Passive Environmental Radon Monitors. This monitoring can also be used to map areas of increased radon concentrations and can be used to provide confirmation of the success of remedial action. Environmental monitoring can provide data that can be used for decision-making by government officials and the general public by replacing uncertainty with knowledge about radon concentrations in the vicinity of remedial action sites. 2 references, 8 figures, 1 table.

6530 **(NLCO—2021) Reduction of beta activity from depleted derbies, ingots and crucibles.** Briggs, G.G.; Schonegg, E.; Kato, T.R. (NLO, Inc., Cincinnati, OH (USA)). Sep 1984. Contract AC05-76OR01156. 20p. (CONF-8410166—3). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003484.

From Plutonium/uranium recovery operations conference; Oak Ridge, TN, USA (16 Oct 1984).

The reduction of beta radiation on uranium ingot and crucible surfaces was demonstrated in the production casting operation by adding a mixture of slag liner material ($MgF_2$) and calcium fluoride to the remelt charge. The beta emitters ($^{234}Th$ and $^{234}Pa$) are largely discharged with the fluorides into drums during a remote crucible burnout operation; thereby, reducing operator exposure to beta radiation. A production test showed that very low beta radiation from uranium flat castings can be achieved by using derbies recently prepared by reduction. Plant tests with fluoride addition indicate that pickling of derbies may not be necessary for casting uranium flats from a plasma sprayed ($ZrO_2$) crucible. Also, ingots produced with fluoride additions had less pipe as compared to standard production technique. 2 references, 5 tables.

6531 **(NUREG/CR—3620) Intruder dose pathway analysis for the onsite disposal of radioactive wastes: the ONSITE/MAXI1 computer program.** Napier, B.A.; Peloquin, R.A.; Kennedy, W.E. Jr.; Neuder, S.M. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1984. Contract AC06-76RL01830. 278p. (PNL—4054). NTIS, PC A13/MF A01 - GPO $8.50. File Number TI85003253.

Because of uncertainties associated with assessing the potential risks from onsite burials of radioactive waste, the US Nuclear Regulatory Commission (NRC) has amended its regulations to provide greater assurance that buried radioactive material will not present a hazard to public health and safety. The amended regulations now require licensees to apply for approval of proposed procedures for onsite disposal pursuant to 10 CFR 20.302. The NRC technically reviews these requests on a case-by-case basis. These technical reviews require modeling potential pathways to man and projecting radiation dose commitments. This document contains a summary of our efforts to develop human-intrusion scenarios and to modify a version of the MAXI computer program for potential use by the NRC in reviewing applications for onsite radioactive waste disposal. The documentation of the ONSITE/MAXI computer program is written for two audiences. The first (Audience A) includes persons concerned with the mathematical models and computer algorithms. The second (Audience B) includes persons concerned with exercising the computer program and scenarios for specific onsite disposal applications. Five sample problems are presented and discussed to assist the user in operating the computer program. Summaries of the input and output for the sample problems are included along with a discussion of the hand calculations performed to verify the correct operation of the computer program. Computer listings of the ONSITE/MAXI1 computer program with an abbreviated data base listing are included as Appendix 1 to this document. Finally, complete listings of the data base with listings of the special codes used to create the data base are included in Appendix 2 as a microfiche attachment to this document.

6532 **(ORNL/EIS—154/V5) Nuclear facility decommissioning and site remedial actions: a selected bibliography. Volume 5.** Owen, P.T.; Knox, N.P.; Chilton, B.D.; Baldauf, M.F. (Oak Ridge National Lab., TN (USA)). Sep 1984. Contract AC05-84OR21400. 546p. (RLO/SFM—80/5). NTIS, PC A23/MF A01; 1; GPO Dep. File Number DE85003697.

This bibliography of 756 references with abstracts on the subject of nuclear facility decommissioning, uranium mill tailings management, and site remedial actions is the fifth in a series of annual reports prepared for the US Department of Energy, Division of Remedial Action Projects. Foreign as well as domestic literature of all types - technical reports, progress reports, journal articles, conference papers, symposium proceedings, theses, books, patents, legislation, and research project descriptions - has been included in this publication. The bibliography contains scientific (basic research as well as applied technology), economic, regulatory, and legal literature pertinent to the US Department of Energy's Remedial Action Program. Major chapters are: (1) Surplus Facilities Management Program; (2) Nuclear Facilities Decommissioning; (3) Formerly Utilized Sites Remedial Action Program; (4) Uranium Mill Tailings Remedial Action Program; (5) Grand Junction Remedial Action Program; (6) Uranium Mill Tailings Management; and (7) Technical Measurements Center. Chapter sections for chapters 1, 2, 4, and 6 include Design, Planning, and Regulations; Environmental Studies and Site Surveys; Decontamination Studies; Dismantlement and Demolition; Site Stabilization and Reclamation; Waste Disposal; Remedial Action Experience; and General Studies. The references within each chapter or section are arranged alphabetically by leading author. References having no individual author are arranged by corporate author or by title. Indexes are provided for the categories of author, corporate affiliation, title, publication description, geographic location, and keywords. The Appendix contains a list of frequently used acronyms.

6533 **(PNL-SA—12708) Development of improved risk assessment tools for prioritizing hazardous and radioactive-mixed waste disposal sites.** Whelan, G.; Steelman, B.L. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1984. Contract AC06-76RL01830. 14p. (CONF-841187—9). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003629.

From 5. DOE environmental protection information meeting; Albuquerque, NM, USA (6 Nov 1984).

It is the intent of all environmental regulations to minimize the risks to man and his environment that arise from a regulated activity. Because lower levels of risk are generally accompanied by higher environmental control costs, optimum management is achieved by balancing risks and costs. Currently, the US Environmental Protection Agency employs the Hazard Ranking System (HRS) to evaluate the environmental risks associated with inactive hazardous waste sites for the purpose of establishing the National Priorities List. Recently, investigators modified the HRS to more realistically evaluate the risks posed by radioactive waste constituents. Although results from applying the modified HRS will be useful for comparing the priority of DOE sites to non-DOE sites, the methodology is still overly subjective. To provide DOE with a better management tool for prioritizing funding allocations for further site investigations and possible remediations, Pacific Northwest Laboratory is developing a more objective, scientifically based, risk assessment methodology called the Remedial Action Priority System (RAPS). This methodology will be developed using empirically, analytically, and semianalytically based mathematical algorithms to predict the potential for contaminant migration from a site to receptors of concern using pathways analyses. Four major

pathways for contaminant migration will be considered in the RAPS methodology: groundwater, overland, surface water, and atmospheric. Using the predictions of contaminant transport, simplified exposure assessments will be performed for receptors of interest. The risks associated with the sites will then be calculated relative to other sites for each pathway and for all pathways together. The RAPS methodology will require minimum user knowledge of risk assessment and the least possible amount of input data, and is being designed to operate on a personal computer. 17 references, 3 figures, 1 table.

6534 **(RLO/SFM—82-2) Surplus Facilities Management Program. Program plan, FY 1983-1987. Abridged edition.** (UNC Nuclear Industries, Inc., Richland, WA (USA). Office of Surplus Facilities Management). Oct 1982. Contract AC06-76RL01857. 153p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE84016869.

The complete Program Plan addressing FY 1983-1987 is divided into three volumes. Volume 1 presents administrative policies, guidelines, and procedures. Volume 2 presents the civilian program work breakdown structure, task/project descriptions, milestone and cost schedules, budget summaries, a current inventory of all SFMP civilian projects and facilities, site descriptions, long range project schedule, and waste volume projections. Volume 3 presents the defense program work breakdown structure, tasks/project descriptions, milestone and cost schedules, budget summaries, a current inventory of all SFMP defense projects and facilities, site descriptions, long range project schedule, and waste volume projections. This abbreviated version of the Program Plan contains only those sections which are considered necessary to explain the objective of the program, the administration control functions and descriptions of identified projects.

6535 **Safety and the processing of nuclear fuel--a success story.** Smith, D.R. (Los Alamos Scientific Laboratory, Los Alamos, NM). pp 20 of Shaping our energy future. Knoxville, TN, USA; LTM Consultants (1984). (CONF-840229—).

From 11. annual WATTec conference and exposition - shaping our energy future; Knoxville, TN, USA (21 Feb 1984).

Abstract only.

During the past 40 years, large quantities of plutonium and enriched uranium have been processed in complex chemical and mechanical operations. This very good safety record is attributable to the concern of management and government, who have provided the safety resources in talent and equipment necessary for the effective control of risks.

## 0550 Regulations

*REFER ALSO TO CITATION(S) 0550006445, 6855, 7184*

6536 **(DP-MS—84-114) Design of an integrated non-destructive plutonium assay facility.** Moore, C.B. (Du Pont de Nemours (E.I.) and Co., Wilmington, DE (USA). Engineering Dept.). 1984. Contract AC09-76SR00001. 9p. (CONF-841007—32). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003658.

From Nuclear science symposium; Orlando, FL, USA (31 Oct 1984).

The Department of Energy requires improved technology for nuclear materials accounting as an essential part of new plutonium processing facilities. New facilities are being constructed at the Savannah River Plant by the Du Pont Company, Operating Contractor, to recover plutonium from scrap and waste material generated at SRP and other DOE contract processing facilities. This paper covers design concepts and planning required to incorporate state-of-the-art plutonium assay instruments developed at several national laboratories into an integrated, at-line nuclear material accounting facility operating in the production area. 3 figures.

6537 **(INIS-mf—9407) Act No. 305 of 2 May 1983. Ratification and execution of the Convention on the Prevention of Marine Pollution by Dumping of Wastes and other Matter, opened for signature in Mexico, London, Moscow and Washington on 29th December 1972, as modified by the amendments annexed to the resolution adopted in London on 12 October 1978.** (Italy). 27 Aug 1983. 1p. (In Italian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85780190.

The London Convention provides for a system classifying radioactive waste for sea dumping. It prohibits the dumping of high level radioactive waste and makes the dumping of other categories of such waste subject to and in compliance with a special permit.

6538 **(INIS-mf—9408) Stb No. 404 - Decree of 12 July 1983 amending the fissionable materials, ores and radioactive substances (Transport) Decree.** (The Netherlands). 12 Jul 1983. 3p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85780191.

For the Netherlands, international carriage by air of radioactive materials is governed by the regulations of the internationl Air Transport Association (IATA) which are partly based on the IAEA's recommendations in this respect. These were revised in 1973, and the present Decree amends the Transport Decree of 1969 to align it with the 1973 revision followed by IATA.

6539 **(PNL—5257) Quality assurance measures applicable to IAEA anomaly and discrepancy resolution (ISPO Task D.52). Program for technical assistance to IAEA safeguards.** Harms, N.L.; Smith, B.W. (Pacific Northwest Lab., Richland, WA (USA)). Nov 1984. Contract AC06-76RL01830. 29p. (ISPO—225). NTIS, PC A03/MF A01; GPO Dep. File Number DE85003661.

The International Atomic Energy Agency (IAEA) safeguards program provides assurance to the international community that nations comply with their commitments for the peaceful use of nuclear energy. This assurance is based on the capabilities of the IAEA safeguards program to detect diversion of nuclear material. Anomalies and discrepancies, which occur in the event of a diversion or concealment, are detected as part of the IAEA safeguards program. Anomalies and discrepancies normally result from innocent causes and it is the purpose of the resolution process to determine the significance of them. The IAEA is instituting quality assurance measures for the IAEA inspection process. This paper reviews the anomaly and discrepancy resolution process and describes quality control measures which are the basis for quality assurance. 13 references, 6 tables.

6540 **(SAND—84-2218C) Non-proliferation policy and safeguards.** de Montmollin, J.M. (Sandia National Labs., Albuquerque, NM (USA)). 15 Oct 1984. Contract AC04-76DP00789. 13p. (CONF-8411113—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE85002439.

From Seminar on nuclear safeguards; College Station, TX, USA (20 Nov 1984).

The evolution of proliferation control measures and the role of safeguards are given.

# 07 ISOTOPE AND RADIATION SOURCE

# TECHNOLOGY

## 0702 Radiation Sources

*REFER ALSO TO CITATION(S) 0702007321, 7333*

## 0703 Isotopic Power Supplies

*REFER ALSO TO CITATION(S) 0703007066, 7138*

6541 **(SC-PR—67-740) Aerospace nuclear safety report for August 1967.** Illing, R.G. (comp.). (Sandia National Labs., Albuquerque, NM (USA)). Sep 1967. Contract AC04-76DP00789. 28p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85000039.

The AEC Safety Branch advised that the present outlook for a potential mission using four modified SNAP-3 type generators is rather negative. Drop tests of four SNAP-19 intact reentry heat source capsules were conducted at the Tonopah Test Range. A preliminary GE SNAP-27 safety analysis was reviewed. Three arc tunnel tests were conducted at low heat fluxes. Debris were collected on downrange impactors from all tests. The rapid helium depressurization test on fuel microspheres was conducted by Battelle; preliminary examination of the fuel revealed no obvious change in microsphere characteristics.

# 08 HYDROGEN

## 0801 Production

*REFER ALSO TO CITATION(S) 0801007210*

6542 **Photoproduction of hydrogen by dye-sensitized systems.** Bi, Z.C.; Tien, H.T. (Michigan State Univ., East Lansing). *International Journal of Hydrogen Energy;* 9: 717-722(1984). Contract FG02-80CS83101.

Visible light-induced production of hydrogen has been investigated in five different systems. These are: safranine O/ETDA, safranine T/EDTA, proflavine/EDTA, acridine orange/EDTA, and acridine yellow/EDTA, with and without added K2PtCl6. In the two safranine systems photoproduction of hydrogen was observed even in the absence of a Pt catalyst. Also, the addition of an electron mediator such as methyl viologen was found not necessary. Acridine yellow/EDTA/K2PtCl6 has been shown to be the best system examined, which upon addition of Triton X-100, showed further enhancement of the rate of hydrogen evolution. 16 references.

## 0802 Storage

6543 **Separation by diffusion of hydrogen clusters in a metal hydrogen system.** Lee, M.H. (Univ. of Georgia, Athens). *Separation Science and Technology;* 18: No. 12-13, 1275-1294(1983). Contract AS09-77ER01023.

Dynamical problems facing hydrogen diffusion in metal hydrogen systems at low temperature are surveyed. A microscopic model is constructed based on the assumption that the functional units are clusters of Fermi or Bose particles, collectively referred to as spin clusters. Critical behavior of metal hydrogen systems provides a key approximation which makes this model solvable. The time-dependent autocorrelation functions are obtained by solving the Heisenberg equation of motion using a new mathematical technique called the recurrence relations. The dynamical solutions shed light on the reversed isotope effect in diffusion. The nature of interstitial spin clusters is examined and compared with atomic and nuclear spin clusters. The spin clusters show striking resemblance to the superfluid component in the two-fluid theory of liquid $^4$He.

# 09 OTHER SYNTHETIC AND NATURAL FUELS

## 0901 Hydrocarbon Fuels

*REFER ALSO TO CITATION(S) 0901107128*

6544 **(DOE/ER/10855—4) Metal-support interactions: their effects upon adsorption, electronic, and activity/selectivity properties of cobalt in CO hydrogenation. Annual progress report, April 1, 1984-March 31, 1985.** Bartholomew, C.H. (Brigham Young Univ., Provo, UT (USA). Dept. of Chemical Engineering). 1 Apr 1985. Contract AC02-81ER10855. 6p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85003316.

Accomplishments are summarized on four research topics: effects of dispersion, % reduction, and preparation on activity/selectivity properties of cobalt; effects of support and dispersion on activity/selectivity properties of iron; effects of support and dispersion on the binding states and binding energies of CO on Co; and effects of support on electronic properties of Co and Fe.

6545 **(DOE/ET/14809—13) Investigation of sulfur-tolerant catalysts for selective synthesis of hydrocarbon liquids from coal-derived gases. Final technical progress report, September 19, 1979-October 22, 1984.** Bartholomew, C.H. (Brigham Young Univ., Provo, UT (USA)). 20 Oct 1984. Contract AC22-79ET14809. 64p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85000648.

The effects of support and of boron or potassium promoters on the adsorption properties, CO hydrogenation activity/selectivity behavior, and sulfur resistance of iron (and to a lesser extent cobalt) were investigated. Iron catalysts supported on alumina, silica, and silicalite and promoted with potassium were prepared by conventional impregnation techniques. Cobalt and iron borides were prepared by chemical reduction with $NaBH_4$. The adsorptions of CO and $H_2$ on these catalysts were studied by static adsorption and temperature-programmed desorption techniques. Activity, selectivity, and sulfur-resistance during CO hydrogenation on these catalysts were determined using a laboratory microreactor. The results indicate that support, promoter, and catalyst pretreatment significantly influence adsorption, activity, selectivity, and sulfur resistance behavior of these catalysts. Hydrogen adsorption on these catalysts is highly activated; moreover the degree of activation varies with support, promoter and pretreatment. Specific activities of iron catalysts on different supports vary 40 fold; selectivities of these catalysts for $CO_2$ and different hydrocarbons also vary significantly with support. Calcination at 473°K of potassium promoted Fe/silica shifts selectivity from conventional Fisher-Tropsch products ($C_1$-$C_{10}$ hydrocarbons and $CO_2$) to mainly methane, ethylene and propylene. These and other significant results are presented and discussed. An account of technical communications and publications is also included. 24 references, 20 tables, 9 figures.

6546 **(DOE/PC/30021—T14) Catalyst and reactor development for a liquid phase Fischer-Tropsch process. Quarterly technical progress report, 1 April-30 June 1983.** Brian, B.W.; Carroll, W.E.; Cilen, N.; Pierantozzi, R.; Nordquist, A.F. (Air Products and Chemicals, Inc., Allentown, PA (USA)). Oct 1984. Contract AC22-80PC30021. 39p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85003151.

Two major tasks of the contract continued: (1) Slurry Catalyst Development, and (2) Slurry Reactor Design Studies. A third phase of the extended slurry test of the proprietary catalyst was conducted using a new catalyst batch to confirm that the change in selectivity and loss of activity, observed in the second phase, was due to air exposure of the catalyst. The results were in line with the high diesel fuel production as before the suspected oxidation. Excess CO exposure during this last phase of testing resulted in a reduction in catalyst activity and a shift in selectivity to heavier hydrocarbons with a Schulz-Flory maximum centered around $C_{30}$. The variations in selectivity and activity upon oxidation through air exposure, or surface carbon deposition through excess CO exposure, have confirmed the importance of understanding the mecha-

nism for product selectivity. Further development with the aid of surface analysis techniques is required to control and center the selectivity for the diesel fuel range. Short term slurry tests were carried out on three catalysts, the preparation and activation procedures of which were optimized by the gas phase screening program. In the hydrodynamic studies, correlations were derived for the 5″ column data. In the 12″ column, fitted with 7 vertical heat transfer tubes, hydrodynamic parameters were determined for slurries of 45 to 90 μm $Fe_2O_3$ in paraffin and water. A double, conical, hot film probe to measure bubble diameter was successfully operated in a three phase slurry. Using Deckwer's model of the three phase bubble column, and kinetic data derived from the lab CSTR tests, the performance of Air Products' selective catalysts in a 1.5 x 8 m column (i.e., the size of Rheinpruessen) was simulated under both quiescent and churn turbulent conditions. 7 references, 8 figures, 6 tables.

6547 **(DOE/PC/40771—14) Fischer-Tropsch synthesis in slurry reactor systems. Quarterly report, August 1-October 31, 1984.** Satterfield, C.N.; Bartos, T. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Chemical Engineering). 1984. Contract FG22-81PC40771. 40p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85002311.

In slurry reactors as used for Fischer-Tropsch synthesis or liquid phase methanol synthesis, an important design factor is the effect of solids loading on gas-liquid mass transfer. Little information is available for organic liquids, which differ significantly from water in their behavior. A detailed study has been completed of the influence of solid particles upon the global mass transfer parameters, k/sub L/a and a, as determined in a mechanically stirred, one-liter autoclave. The interfacial area, a, was evaluated by the unsteady state absorption with simultaneous reaction in the fast-reaction regime of $CO_2$ with cyclohexylamine in a 90% toluene and 10% isopropanol mixture. The overall mass transfer coefficient, k/sub L/a, was determined by the unsteady state desorption of helium from a helium-saturated solution of cyclohexylamine in the toluene and isopropanol mixture into a nitrogen purge stream. Experiments were conducted at near-ambient conditions. Mixtures of 6 to 8% $CO_2$ in $N_2$, a superficial gas velocity of 0.75 cm/s, and solutions of 0.25 M cyclohexylamine were used. Stirring speeds ranged from 350 to 1750 rpm. The solid properties investigated were particle concentration (0 to 45 vol %), size (35 to 200 μm), density 0.7 to 4.5 g/ml), and composition (glasses of several densities, polytetrafluoroethylene, and polypropylene). To evaluate the mass transfer parameters, the liquid and solid phases were modelled as a single homogeneous slurry phase behaving as a CSTR, while the gas phase was modelled as a PFR with recycle. Varying the recycle ratio, R, allowed the entire spectrum of gas phase mixing possibilities (CSTR to PFR) to be modelled. 34 references.

6548 **(DOE/PC/60795—4) Characterization of iron catalysts for Fischer-Tropsch synthesis. Technical progress report, 1 July 1984-30 September 1984.** (Northwestern Univ., Chicago, IL (USA). Dept. of Chemistry). Nov 1984. Contract FG22-83PC60795. 3p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85003130.

A primary goal of this research is to use x-ray photoelectron and Auger electron spectroscopy to characterize the active surfaces formed on iron catalysts during hydrocarbon synthesis. The first phase of the work involves characterization of reference compounds, to demonstrate how this technique can be used to distinguish between the various iron states likely to be present on the catalyst surfaces. To date, iron, oxygen, and carbon core level, iron Auger, and valence band spectra have been measured for a number of materials. These include clean metal foils, reduced metal powders, bulk $Fe_3O_4$ and $\alpha$-$Fe_2O_3$ powders, oxide overlayers on iron foils, and carbided powders and foils. Results of these investigations are summarized.

6549 **(DOE/PETC/TR—85/2) Catalytic conversion of $C_3$-$C_4$ paraffins to gasoline.** Batchelder, R.F.; Pennline, H.W.; Schehl, R.R.; Finseth, D.H. (USDOE Pittsburgh Energy Technology Center, PA). Dec 1984. 40p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85004181.

The reaction of propane and butane to form gasoline-range hydrocarbons in a single-step catalytic process has been investigated in a tubular packed-bed reactor maintained at near isothermal conditions. Three catalyst systems were studied: a zeolite, ZSM-5; a dehydrogenation catalyst, chromia-alumina; and a 50:50 mixture by weight of the previous two catalysts. The effects of process parameters on the catalyst activity and product selectivity were determined. It was found that ZSM-5 alone will convert propane or butane to gasoline-range products over a temperaure range of 350° to 540°C. The reaction of butane over ZSM-5 results in a large selectivity to propane (30 to 70 weight percent) depending on the temperature. The addition of chromia-alumina to ZSM-5 increased the first-order rate constant for butane conversion by 60% at 450°C. The addition of chromia-alumina to ZSM-5 also increased the C/sub 5+/ selectivity for butane conversion by 30% at 540°C. The addition of chromia-alumina to ZSM-5 had little effect on the rate of propane conversion, but it did increase the C/sub 5+/ selectivity for propane conversion by over 100% at 540°C. The liquid product from alkane conversion was highly aromatic (>80%) under all conditions tested. 12 references, 8 figures.

6550 **Mechanisms of catalytic biomass gasification.** Baker, E.G.; Mudge, L.K. (Pacific Northwest Lab., Richland, WA). *Journal of Analytical and Applied Pyrolysis;* **6**: No. 3, 285-297(Aug 1984).

Possible mechanisms for the pyrolytic reaction of biomass with steam in the presence of alkali carbonate and suported-nickel catalysts are discussed. In addition to catalyzing the carbon/steam reaction, the alkali carbonates alter the biomass pyrolysis reaction pathways, producing gas and char at the expense of tars. Nickel catalysts, while quite effective for secondary tar and gas reactions, tend to lose activity over time; therefore, studies of these catalysts were directed toward identifying mechansisms of carbon deposition, the primary cause of catalysts deactivation.

6551 **Alkali catlysis in biomass gasification.** Elliott, D.C.; Hallen, R.T.; Sealock, L.J. Jr. (Pacific Northwest Lab., Richland, WA). *Journal of Analytical and Applied Pyrolysis;* **6**: No. 3, 299-316(Aug 1984).

The mechanism of biomass gasification in the presence of alakli catalysts was investigated using two reactor systems. Tests at both high pressure and low temperature as well as low pressure and high temperature confirmed that an increase in gas production from whole biomass and biomass components is achieved in the presence of alkali. Supporting investigations elucidated the chemical pathways affected by the alkali and the alkali's effect on several physical parameters. The char-steam reaction was judged not to be diffusion limited in our high-temperature system. In addition, alkali-induced swelling of biomass was determined to be unrelated to the catalytic effect.

## 0902 Alcohol Fuels

*REFER ALSO TO CITATION(S) 0902206272, 6547, 6961*

6552 **(DOE/ER/10623—T3) Identify and assess biomass research and development. Technical status report.** (Viking Energy Corp., Pittsburgh, PA (USA)). 15 Dec 1980. Contract AC01-80ER10623. 16p. NTIS, PC A02. File Number TI85001597.

This study addresses the energy potential of biomass byproducts from agricultural or farm operations and from industrial operations. Consideration is given to agricultural commodities with On-Farm and Off-Farm applications. The analysis is further subdivided according to applications in which biomass fuel may substitute for petroleum fuels, and secondly, the specific nature of the biomass byproducts as it relates to energy content and specific requirements for conversion to useful fuel. Ethanol and methane production are evaluated. Data on petroleum consumption in agriculture are presented, as well as energy use by fuel type in biomass industries. The energy potential is calculated for agricultural wastes and manures and the heating values for selected wastes are tabulated. 8 references, 2 figures, 8 tables. (DMC)

**6553 (DOE/PC/50810—T8) Promotion effects on the synthesis of higher alcohols. Ninth quarterly report, July 1984-September 1984.** Goodwin, J.G. Jr.; Chuang, S.C. (Pittsburgh Univ., PA (USA). Dept. of Chemical and Petroleum Engineering). Oct 1984. Contract FG22-82PC50810. 14p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85002338.

This study has demonstrated that the synthesis of $C_2$ oxygenates from CO hydrogenation is closely related to the synthesis of $C_3$ oxygenates from reaction of $C_2H_4$ with $CO/H_2$. It also confirm the reaction scheme for the synthesis of hydrocarbons and oxygenats as proposed by various investigators. The selectivity and activity of a Rh catalyst is dependent on its ability to catalyze those specific reaction steps such as CO dissociation, hydrogenation and CO insertion. These specific reaction steps were found to be strongly dependent on the type of alkali promoter, support and reaction conditions. The overall effect of alkali promoters on $Rh/La_2O_3$ in the synthesis of oxygenated compound can be summarize as follows: (1) Li-promotion enhance CO inservation step and slightly affected hydrogenation steps over $Rh/La_2O_3$ resulting an increase in selectivity and rate of the formation of $C_2$ oxygenated compounds during CO hydrogenation and an increase in selectivity and rate of the formation of $C_3$ oxygenated compounds during reaction of ethylene with $CO/H_2$; and (2) K and Cs promoters suppress both CO insertion and hydrogenation over $Rh/La_2O_3$ resulting in a decrease in selectivity and activity to oxygenated compounds and a decrease in overall activity. 15 references, 5 tables.

**6554 (NP—5770074, pp 94-95) Chemical feedstocks from cellulose.** Wagner, F. 1984. (In German). NTIS (US Sales Only), PC A09/MF A01. File Number TI85770074.

In GBF scientific progress report 1983.

Cellulomonas uda, a mesophile, facul optionally anaerobic bacterium is able to break down not only cellulose and ligno cellulose containing substrates but also hemicellulose and starch. The field strain has a relatively high ethanol tolerance and converts hexoses and pentoses into ethanols and low-molecular organic acids, there by creating the preconditions for developing a procedure for the production of ethanol and/or L/lactic acid, from vegetable waste.

**6555 (NP—5770074, pp 101-104) Process development.** Schuegerl, K. 1984. (In German). NTIS (US Sales Only), PC A09/MF A01. File Number TI85770074.

In GBF scientific progress report 1983.

The item 'process development' comprises the production of acetonic/butonal with C. acetobylicum and the yeasting of potato waste. The target is to increase productivity by taking the following measures - optimation of media, on-line process analysis, analysis of reaction, mathematic modelling and identification of parameters, process simulation, development of a state estimator with the help of the on-line process analysis and the model, optimization and adaptive control.

**6556 Economic evaluation of alternative ethanol fermentation processes.** Maiorella, B.L.; Blanch, H.W.; Wilke, C.R. (Lawrence Berkeley Lab., CA). *Biotechnology and Bioengineering;* **26**: No. 9, 1003-1025(1984).

Eleven alternative fermentation schemes for ethanol production are compared. Conventional batch, continuous, cell recyle, and immobilized cell processes, as well as membrane, extraction, and vacuum processes which remove ethanol from the broth selectively as it is produced, are considered. The processes are compared on identical bases using a consistent model for the yeast metabolism. Both molasses and cellulose hydrolyzate are considered as feeds. Optimized ethanol plants, including feed preparation, fermentation, and product recovery sections are designed and total costs are projected.

**6557 Continuous, farm-scale, solid-phase fermentation process for fuel ethanol and protein feed production from fodder beets.** Gibbons, W.R.; Westby, C.A.; Dobbs, T.L. (South Dakota State Univ., Brookings). *Biotechnology and Bioengineering;* **26**: No. 9, 1098-1107(1984).

Fuel ethanol (95%) was produced from fodder beets in two farm-scale processes. In the first process, involving conventional submerged fermentation of the fodder beets in a mash, ethanol and a feed (PF) rich in protein, fat, and fiber were produced. Ethanol yields of 70 L/metric ton (17 gal/ton) were obtained; however, resulting beers had low ethanol concentrations {3-5% (v/v)]. The high viscosity of medium and low sugar, beet mashes caused mixing problems which prevented any further increase of beet sugar in the mash. This severely limited the maximum attainable ethanol concentration during fermentation, thereby making the beer costly to distill into fuel ethanol and the process energy inefficient. In order to achieve distillably worthwhile ethanol concentrations of 8-10% (v/v), a solid phase fermentation process (continuous) was developed and tested. In preliminary trials, this system produced fermented pulp with over 8% (v/v) ethanol corresponding to an ethanol yield of 87 L/metric ton (21 gal/ton). Production costs with this novel process are $0.47/L ($1.77/gal) and the energy balance is 2.11. These preliminary cost estimates indicate that fodder beets are potentially competitive with corn as an ethanol feedstock. Additional research, however, is warranted to more precisely refine individual costs, energy balances and the actual value of the PF.

**6558 Comparison of two empirical models for the enzymatic hydrolysis of pretreated poplar wood.** Holtzapple, M.T.; Caram, H.S.; Humphrey, A.E. (Army Natick R and D Lab., MA). *Biotechnology and Bioengineering;* **26**: No. 8, 936-941(1984). Contract AC02-76ET20025.

Two empirical models for the enzymatic hydrolysis of cellulose are used to analyze the same set of experimental data to determine if one model is superior to the other. Both models adequately describe the data. The parameters in both models may be correlated to the hydrolysis conditions of enzyme, substrate, and product inhibitor concentrations. Both empirical models have features which are consistent with theoretical models of cellulose hydrolysis.

**6559 Feed component inhibition in ethanolic fermentation by Saccharomyces cerevisiae.** Maiorella, B.L.; Blanch, H.W.; Wilke, C.R. (Univ. of California, Berkeley). *Biotechnology and Bioengineering;* **26**: No. 10, 1155-1166(1984). Contract AC03-76SF00098.

Inhibition by secondary feed components can limit productivity and restrict process options for the production of ethanol by fermentation. New fermentation processes (such as vacuum or extractive fermentation), while selectively removing ethanol, can concentrate nonmetabolized feed components in the remaining broth. Stillage recycle to reduce stillage waste treatment results in buildup of nonmetabolized feed components. Continuous culture experiments are presented establishing an inhibition order: $CaCl_2$, $(NH_4)_2SO_4$ > NaCl, $NH_4Cl$ > $KH_2PO_4$ > xylose, $MgCl_2$ > $MgSO_4$ > KCl. Reduction of the water activity alone is not an adequate predictor of the variation in inhibitory concentration among the different components tested. As a general trend, specific ethanol productivity increases and cell production decreases as inhibitors are added at higher concentration. It is postulated that these results can be interpreted in terms of an increase in energy requirements for cell maintenance under hypertonic (stressed) conditions. Ion and carbohydrate transport and specific toxic effects are reviewed as they related to the postulated inhibition mechanism. Glycerol production increases under hypertonic conditions and glycerol is postulated to function as a nontoxic osmoregulator. Calcium was the most inhibitory component tested, causing an 80% decline in cell mass production at 0.23 mol $Ca^{2+}$/L and calcium is present at substantial concentration in many carbohydate sources. For a typical final cane molasses feed, stillage recycle must be limited to less than one-third of the feed rate; otherwise inhibitory effects will be observed.

## 0904 Solid Waste And Wood Fuels

*REFER ALSO TO CITATION(S) 0904006960*

**6560 (NP—5900394) Renewable energy: energy from wood.** (Florida Governor's Energy Office, Tallahassee (USA)). Jun 1983. 30p. The Governor's Energy Office, The Capital, Tallahassee, FL 32301. File Number TI85900394.

Florida can expect an expanded use of wood as an energy source. The use of wood as a fuel in Florida has grown rapidly in

recent years and now constitutes 4.5 percent of Florida's total energy use. Because of the availability of wood and the activities of the paper and forest products industries, Florida's share of energy derived from wood is well above the national average. As a result, wood has contributed substantially to efforts to diversify sources of energy in Florida and to reduce dependence on foreign petroleum. Through the rest of this decade, wood will continue to be the largest source of renewable energy in the state. Direct combustion of wood will remain the preferred means to convert wood to energy, due to its use in the pulp and paper industry and in residential woodstoves and fireplaces. Small wood-products industries will begin to use wood fuel both to offset rising prices of conventional energy and to dispose of wood scraps and waste. The conversion technologies to support this expansion are available and ready for use, although advances and refinements can be expected to occur. The major problems of greater wood utilization arise from more intensive forest management and harvesting practices that may adversely impact land use and quality. Increased residential use of wood may contribute to local air pollution problems due to the inefficient combustion that occurs in home heating units. Attention to these problems should reduce their potential impacts while allowing the state to realize the positive benefits of widely using its significant wood resource for energy. 32 references, 2 figures, 1 table.

6561 **(PB—84-238583) Cost-effective trucking distances for woody biomass fuels. Forest service research note.** Eza, D.A.; McMinn, J.W.; Dress, P.E. (Forest Service, Asheville, NC (USA). Southeastern Forest Experiment Station). 21 Aug 1984. 5p. NTIS, PC A02/MF A01.

Transportation costs and alternate energy prices were used to determine maximum distances woody fuels can be transported economically. Currently, costs of most woody materials would have to exceed $20 per ton to restrict trucking distances to 50 miles or less. At the highest alternate energy prices anticipated for the short term, most woody biomass could be hauled at least 50 miles, even at a cost of $35 per ton.

6562 **(STU—76-6432) Instrument for measuring moisture in wood chips.** Werme, L. (Styrelsen foer Teknisk Utveckling, Stockholm (Sweden)). Jun 1980. 9p. (In Swedish). NTIS (US Sales Only), PC A02/MF A01. File Number DE82900931.

A method to determine the moisture content in wood chips, in batch and on-line, has been investigated. The method can be used for frozen and nonfrozen chips. Samples of wood chips are thawed and dried with microwaves. During the drying the sample is weighed continously and the rate of drying is measured. The sample is dried to 10% moisture content. The result is extrapolated to the drying rate zero. The accuracy at the method is 1.6 to 1.7% for both frozen and nonfrozen chips. The accuracy of the method is considered acceptable, but sophisticated sampling equipment is necessary. This makes the method too complex to make the instrument marketable.

6563 **(SVF—147) Wood fuel and pulp wood production at terminals.** Segerud, K. (Stiftelsen foer Vaermeteknisk Forskning, Stockholm (Sweden)). Dec 1983. 127p. (In Swedish). NTIS (US Sales Only), PC A07/MF A01. File Number DE85750207.

The so called whole-tree method has during recent years replaced the conventional assortment method for thinning younger stands at several locations in Sweden. Unlimbed logs are processed at wood terminals into pulp wood and wood fuel. Today the pulp industry is consuming the wood fuel itself, but when the whole-tree method is more widely introduced, a large amount of wood fuel will be available for other consumers, especially the town-heating companies. The aim of this study has been to investigate: Consumers quality demand on the wood fuel. The necessary treatment of the wood fuel at the terminal to fulfil the demand of the consumers. Payable price for wood fuel. Rate of return for wood fuel and pulp wood production at separate terminals and at terminals located at pulp mills. One of the conclusions of this study is that production of wood fuel and pulp wood at the debarking station at the pulp mill is more economical than production at separate terminals. Wood fuel is however inhomogeneous fuel, moisture content 35-60 percent, ash content 2.5-4.5 percent. Therefore wood fuel calls for more rigid fuel handling equipment than fuel chips. Combustion furnaces and firing grates designed for fuel chips have turned out not to be quite suitable for wood fuel. Another conclusion from the study is that if fuel oil firing is the alternative, if wood fuel can be purchased at 450 SEK/ton DS. Coal and peat as alternatives brings the payable price on wood fuel down to 330 SEK/ton DS.

# 14 SOLAR ENERGY

## 1401 Resources And Availability

6564 **(NP—5900020) Use of existing meteorological information for solar energy application. Handbook of Methods of Estimating Solar Radiation. Task V.** (Sveriges Meteorologiska och Hydrologiska Inst., Stockholm). Apr 1983. 116p. NTIS (US Sales Only), PC A06. File Number DE85900020.

The Handbook of Methods of Estimating Solar Radiation begins with the classification of estimating models. A catalogue of estimating methods in which selected models are described in a uniform manner is included. Various statistical techniques that have been used to evaluate performance of estimation models are reviewed. Available measured data sets of solar radiation and relevant meteorological observations of potential use for model validation are described.

## 1403 Economics

6565 **(PNL—5255) Assessment of industry views on international business prospects for solar thermal technology.** Easterling, J.C. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1984. Contract AC06-76RL01830. 53p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85000151.

This report contains a review of solar thermal industry viewpoints on their prospects for developing international business. The report documents the industry's current involvement in foreign markets, view of foreign competition in overseas applications, and view of federal R and D and policy requirements to strengthen international business prospects. The report is based on discussions with equipment manufacturers and system integrators who have a product or service with potential international demand. Interviews with manufacturers and system integrators were conducted by using a standard format for interview questions. The use of a standard format for questions provided a basis for aggregating similar views expressed by US companies concerning overseas business prospects. A special effort was made to gather responses from the entire solar thermal industry, including manufacturers of line-focus, point-focus, and central receiver systems. General, technical, economic, institutional, and financial findings are provided in this summary. In addition, Pacific Northwest Laboratory (PNL) recommendations are provided (based upon advice from the Solar Thermal Review Panel) for activities to improve US solar thermal business prospects overseas.

## 1404 Environmental, Legal, And Institutional Aspects

*REFER ALSO TO CITATION(S) 1404006565*

6566 **(DOE/CS/30280—T2) Model plans for establishing a municipal solar utility. Technical status report No. 11, 4 August-7 September 1980.** Bartera, R.E. (Solar Resources, Inc., Culver City, CA (USA)). 1980. Contract AC03-79CS30280. 43p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE83003298.

This report provides a summary description of the Solar Organization of Los Angeles (SoLA), which might be called a solar municipal utility. Its ultimate purpose would be to deliver solar energy to customers as a service for a fee, similar to any utility service. Using this approach, SoLA could help resolve the two greatest barriers to rapid consumer acceptance of solar energy: high first cost and fear the technology won't work.

## 1405 Solar Energy Conversion

*REFER ALSO TO CITATION(S) 1405006550, 6551, 6552, 6554, 6555, 6556, 6557, 6558, 6559, 6560, 6561, 6960, 6961, 7028*

6567 **(CONF-8211193—) Fuelwood management and utilization seminar: proceedings.** Obyc, R.J. (comp.). (Forest Service, Broomall, PA (USA). Northeastern Area, State and Private Forestry; Michigan State Univ., East Lansing (USA). Dept. of Forestry). 1982. 182p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE85000687.

From Fuelwood management and utilization seminar; East Lansing, MI, USA (9 Nov 1982).

Papers presented at the seminar are included in this proceedings. Silvicultural and other management techniques for the development of private non-industrial woodloads for participation in the fuelwood market are discussed. Properties of wood, wood heating systems, productivity of wood lots, and harvesting techniques are also convered. Reports on the progress and programs underway in each state are presented at the end of the seminar proceedings. Separate abstracts have been prepared for selected items for inclusion in the Energy Date Base. (DMC)

6568 **(DOE/ER/13026—3) Low cost, sprayed $CuInSe_2$ solar cell research. Annual progress report, September 15, 1983-September 15, 1984.** Squillante, M.R.; Moy, L.; Entine, G. (Radiation Monitoring Devices, Inc., Watertown, MA (USA)). 1984. Contract AC02-82ER13026. 33p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85003467.

This research is investigating a promising new spray pyrolysis technique for depositing cost effective thin films of $CuInSe_2$ for terrestrial solar cell applications. This process is attractive because of its inherent simplicity which should permit large scale production of high quality thin films at low cost. This program is directed at determining the chemical and physical conditions required to produce high quality films and at characterizing and understanding the properties of the films produced. During this research effort we have investigated the spray solution chemistry, the deposition parameters, the film properties, and the characteristics of solar cell devices fabricated using the sprayed films. The results are very encouraging but further work is needed to fully examine the use of this unique deposition process in the manufacturing of $CuInSe_2$ solar cells.

6569 **(DOE/JPL/1012—99) Flat-Plate Solar Array Project. Progress report 23, September 1983 to March 1984, and proceedings of the 23rd Project Integration Meeting.** (Jet Propulsion Lab., Pasadena, CA (USA)). 1984. Contract AI01-76ET20356. 519p. (JPL-PUB—84-47). NTIS, PC A22/MF A01; 1; GPO Dep. File Number DE85003481.

This report describes progress made by the Flat-Plate Solar Array Project during the period September 1983 to March 1984. It includes reports on silicon sheet growth and characterization, module technology, silicon material, cell processing and high-efficiency cells, environmental isolation, engineering sciences, module reliability and project analysis and integration. It includes a report on, and copies of visual presentations made at the 23rd Project Integration Meeting held at Pasadena, California, on March 14 and 15, 1984.

6570 **(NP—5770082) Study on the development of silicon solar cells.** (Ludwig-Boltzmann-Institut fuer Festkoerperphysik, Vienna (Austria)). 26 Jan 1982. 23p. (In German). NTIS (US Sales Only), PC A02/MF A01. File Number DE85770082.

In 1981 work has been done for the following development steps: setup of a new chemical vapor deposition system, fabrication of solar cells on polycrystalline substrates, and improvement of the methods for the characterisation of solar cells.

6571 **(SERI/STR—211-2439) Preparation and properties of $CuInSe_2$ crystals.** Bachmann, K.J. (North Carolina State Univ., Raleigh (USA)). Oct 1984. Contract AC02-83CH10093. 28p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85000520.

This report presents results of research performed to supplement development work on thin-film materials by investigation well-defined single crystals, including studies of fundamental properties of $CuInSe_2$ solar cells. The emphasis was on phase diagram evaluation and a systematic survey of alternative crystal growth methods. A number of fundamental studies of the electrical transport properties and surface chemistry of $CuInSe_2$ were also performed in close cooperation with both government and private research laboratories. A novel $CuInSe_2$ solar cell was invented in collaboration with two European organizations and is discussed.

6572 **(SERI/STR—211-2498) Photovoltaic devices using a-Si:H from higher order silanes. Semiannual report, 1 September 1983-29 February 1984.** Delahoy, A.E. (Chronar Corp., Princeton, NJ (USA)). Oct 1984. Contract AC02-83CH10093. 38p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85000522.

This report summarizes research performed during a six-month period on hydrogenated amorphous silicon, prepared by chemical vapor deposition using flow methods rather than a static method in order to deposit from a time-invariant gas phase chemistry. Both low-pressure and atmospheric-pressure systems were employed. The feedstock gases were electronic-grade higher order silanes (principally disilane) manufactured by silent electric discharge. Because of the historically poor performance of CVD p layers in p-i-n devices, an effort was made to develop a higher quality p layer. Both silane/diborane and disilane/diborane mixtures were investigated. Using disilane/diborane mixtures at low pressures and very low temperatures (200°C) significantly improved LPCVD p layers. P-i-n devices employing these p layers exhibited open-circuit voltages up to 723 mV.

6573 **(SERI/STR—211-2506) Preparation of silicon substrates for gallium arsenide solar cells. Semiannual report, February 1983-September 1983.** (Spire Corp., Bedford, MA (USA)). Oct 1984. Contract AC02-83CH10093. 33p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85000521.

This report describes a process and structure for the fabrication of high-efficiency GaAs-GaAlAs heteroface solar cells. A GaAs-GaAlAs solar cell with AMl efficiency greater than 20% has been fabricated on a single-crystal GaAs substrate, and a GaAs-GaAlAs solar cell showing high open-circuit voltage has been fabricated on a single-crystal bulk-Ge substrate. Films of GaAs grown on Ge-coated Si substrates have been measured and shown to have $10^{16}$ defects/cm$^2$. Smooth, single-crystal films of GaAs have also been deposited directly on bare Si substrates. These films on bare Si have been measured and shown to have $5 \times 10^6$ defects/cm$^2$.

6574 **(SERI/STR—211-2513) Studies of chemical vapor deposition of amorphous silicon and transparent electrodes for Solar Cells III. Status report, 1 April-30 June 1984.** Gordon, R.G.; Kurtz, S.; Proscia, J.; Gustin, K.; Chapple-Sokol, J.; Strickler, D. (Harvard Univ., Cambridge, MA (USA). Dept. of Chemistry). Oct 1984. Contract AC02-83CH10093. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85000523.

This is the third progress report on research studies of chemical vapor deposition (CVD) of amorphous silicon and transparent electrodes for solar cells. An apparatus for measuring minority carrier diffusion lengths, a surface photovoltage system, was calibrated and found to obtain reproducible results. Surface photovoltages of several samples of CVD a-Si were measured, and diffusion lengths ranged from 0.1 to 0.4 micron. The highest diffusion length values were found in samples grown in the early part of the gas flow, implying that either a higher quality film is formed from $SiH_2$ precursors than from others or that a small amount of boron doping early in the process produces a better film.

6575 **(SERI/STR—211-2517) $CuInSe_2$ photovoltaic diodes. Final report, 1 May 1981-1 May 1984.** Sites, J.R. (Colorado State Univ., Fort Collins (USA)). Oct 1984. Contract AC02-83CH10093. 31p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85000519.

Several critical factors in understanding the basic operation of CdS/$CuInSe_2$ thick film solar cells are identified. Contributing to

the attractiveness of such cells are (1) the high optical absorption of $CuInSe_2$, (2) a generally high quantum efficiency, and (3) a respectable built-in potential. Detracting from the performance of cells examined to date are (1) a granular structure that can exhibit a spread in built-in potential and regions of lowered quantum efficiency, (2) a somewhat excessive series resistance, (3) a diode current dominated by recombination traps at the junction, and (4) other interfacial traps that lower the built-in potential on exposure to light.

6576 **(SERI/STR—231-2496) Research and development of shallow algal mass culture systems for the production of oils.** Laws, E.A. (Hawaii Univ., Honolulu (USA)). Oct 1984. Contract AC02-83CH10093. 59p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85000518.

The major accomplishment of the past nine months' work was the identification of a microalgal species which can be grown in the system on a 12-month basis without temperature control. The most promising species identified to date is a strain of platymonas sp. This strain grows rapidly at temperatures from 20° to 34°C, and at salinities from 1.5 to 3.5%. Neither the lower temperature limit nor the lower salinity limit of the strain are known at this time. A factorial experiment designed to determine optimum growth conditions indicated that the optimum culture depth was 10 cm, the optimum pH about 7.5, and the optimum flow rate about 30 cm/s. A major discovery was that diluting the culture every third day greatly enhanced production. In this dilution mode daily yields averaged 46 $g/m^2$ ash-free dry weight (AFDW) over a one-month period, and photosynthetic efficiencies averaged 11% (based on visible light energy). The former figure is over twice the best long-term yields achieved in microalgal mass culture systems grown exclusively on inorganic nutrients.

6577 **(SERI/TP—211-2520) US Amorphous Silicon Research Project.** Sabisky, E. (Solar Energy Research Inst., Golden, CO (USA)). Nov 1984. Contract AC02-83CH10093. 6p. (CONF-841129—4). NTIS, PC A02/MF A01; GPO Dep. File Number DE85000536.

From 1. international photovoltaic science and engineering conference and exhibition; Kobe, Japan (13 Nov 1984).

The US Department of Energy (DOE) established the Amorphous Silicon Research Project (ASRP) in 1983 at the Solar Energy Research Institute (SERI). The ASRP was given the responsibility for developing an Amorphous Silicon Research Plan. A summary of this research plan is presented.

6578 **(SERI/TP—211-2537) Photoelectrochemical cells with and without storage based on II-VI semiconductor materials.** Wallace, W.L. (Solar Energy Research Inst., Golden, CO (USA)). Nov 1984. Contract AC02-83CH10093. 6p. (CONF-841129—3). NTIS, PC A02. File Number DE85000531.

From 1. international photovoltaic science and engineering conference and exhibition; Kobe, Japan (13 Nov 1984).

Research on electrochemical photovoltaic cells incorporating thin film n-CdSe and n-CdSe/sub 1-x/Te/sub x/ photoanodes has resulted in efficiencies up to 7.5% using small area electrodes in polysulfide electrolytes. Efficiencies close to 10% can be achieved using alternate electrolytes in significantly less stable systems. Research on $CuInSe_2$ electrochemical photovoltaic cells has resulted in efficiencies up to 11.7% using single crystal n-$CuInSe_2$ photoanodes in aqueous electrolytes. A review will also be given on the status of photoelectrochemical storage research.

6579 **(SERI/TP—211-2543) Role of research and development in the worldwide deployment of photovoltaics.** Stone, J.; Ritchie, D.; Deb, S.; Surek, T. (Solar Energy Research Inst., Golden, CO (USA)). Nov 1984. Contract AC02-83CH10093. 6p. (CONF-841129—2). NTIS, PC A02. File Number DE85000532.

From 1. international photovoltaic science and engineering conference and exhibition; Kobe, Japan (13 Nov 1984).

The dream of significant electrical energy production for all mankind may well be fulfilled by photovoltaics. The attainment of this objective will be determined primarily by the cost and performance of future technologies. The role of research and development will be significant. Advanced thin films materials and very high efficiency concepts are being pursued as potentially viable technologies for worldwide deployment in energy significant quantities. R and D opportunities are discussed with emphasis on progress to date, significant technical barriers to be overcome, and future R and D direction.

6580 **(SERI/TP—212-2528) Preliminary studies on the low-cost preparation of chalcogenide semiconductors from solution depositions.** Chen, Y.W.; Turner, J.A.; Noufi, R. (Solar Energy Research Inst., Golden, CO (USA)). Nov 1984. Contract AC02-83CH10093. 16p. (CONF-841058—11). NTIS, PC A02/MF A01; GPO Dep. File Number DE85000538.

From Fall meeting of the Electrochemical Society; New Orleans, LA, US (7 Oct 1984).

Low-cost solution deposition processes such as electrodeposition, chemical conversion and electrochemical conversion have been employed to prepare chalcogenides and chalcopyrites such as Cu-Se, Cu-Te, Cd-Se, Cd-Te, Cu-In-Se, and Cu-In-Te systems. The deposition processes were studied by cyclic voltammetry, rotating disk, rotating ring disk, x-ray diffraction, and surface analyses. The as-deposited films are amorphous and exhibited p-type photovoltaic activity. The electrodeposition of copper selenides on n-Si and n-CdX (X = S, Se, Te) showed that heterojunctions were formed.

6581 **(SLU-ESO-TR—32) Simulation of total willow production.** Eckersten, H.; Kowalik, P.; Nilsson, L.O.; Perttu, K. (Sveriges Lantbruksuniversitet, Uppsala. Inst. foer Ekologi och Miljoevaard). 1983. 46p. (EFP-TR—32). NTIS (US Sales Only), PC A03/MF A01. File Number DE85750230.

A simple model for willow production as a function of air temperature and solar radiation is presented. The influence of temperature variable is nil below +5 C degrees and unity above +15 C degrees, whereas intermediate values are linearily related. Solar radiation is used in the form of duration of sunshine, expressed as the ratio between period of bright sunshine and day length. Processes included in the model are: photosynthesis, light penetration into canopy, respiration, allocation between above- and below-ground parts, and allocation between stems and leaves. Other factors influencing growth are assumed to be close to optimal, e.g., water-supply and nutrition. The model is tested on willow, using actual climate data and seasonal field measurements of growth of annually coppiced shoots of established stands. Good agreement between simulated growth and field measurements was obtained for two sites with different climates and plant densities expressed in stools x $m^{-2}$. Comparisons between simulated values from different locations show, for instance, that both the above-ground biomass production and the maximal leaf area index (LAI) at Luleaa during 1981 was less than half compared to Koeping. Both measured and simulated production clearly show that annual production is considerable higher in two- than in one-year rotations.

6582 **Electrochemical photovoltaic cells and electrodes.** Skotheim, T.A. (to Dept. of Energy). US Patent 4,471,036. 11 Sep 1984. Filed date 29 Jun 1983. vp.

Improved electrochemical photovoltaic cells and electrodes for use therein, particularly electrodes employing amorphous silicon or polyacetylene coating are produced by a process which includes filling pinholes or porous openings in the coatings by electrochemical oxidation of selected monomers to deposit insulating polymer in the openings.

6583 **The photoresponse of $CdS/CuInSe_2$ thin - film heterojunction solar cells.** Hegedus, S.S. (Institute of Energy Conversion, Univ. of Delaware, Newark, DE). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Electron Devices;* **ED-31**: No. 5, 629-633(May 1984).

The effect of light bias on the spectral current response and spectral capacitance characteristics of $CdS/CuInSe_2$ thin-film heterojunction solar cells has been investigated. Monochromatic light bias has been used to identify specific wavelength regions responsible for the spectral behavior seen under white light bias. Variations with light or voltage bias are consistent with the effect of the field on interface recombination in both high and low CdS resistivity de-

vices. Devices with high CdS resistivity show spectrally dependent enhancement and quenching effects very similar to those reported for CdS/$Cu_2S$ devices in which the space charge region was primarily in the CdS. It is concluded that in high CdS resistivity devices the junction behavior is controlled by the photoconductive CdS as has been established in CdS/$Cu_2S$ cells. Low CdS resistivity CdS/$CuInSe_2$ devices show none of these effects.

6584 **Electron channeling and EBIC studies of edge-supported pulling silicon sheets.** Tsuo, Y.S.; Hurd, J.L. (Solar Electric Conversion Research Division, Solar Energy Research Institute, Golden, CO). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Electron Devices;* **ED-31**: No. 5, 614-618(May 1984).

The dominant grain structure in edge-supported pulling silicon sheets has been studied by electron channeling in a scanning electron microscope. For unseeded polycrystalline silicon sheets in which equilibrium grain structures have been attained, it was found that the dominant grain structure is long, narrow grains with surface normals less than twenty degrees off the (011) direction. The plane that is parallel to the growth direction and perpendicular to the surfaces for most of these grains is very close to (111). The electronic quality of the grains, determined by electron-beam-induced current measurements, has been correlated with crystallographic orientations determined by electron channeling. It was observed that grains with this kind of grain structure tend to have better electronic quality, i.e., less electrically active intragrain defects, than the random grains. These findings are consistent with past experience that larger grained polycrystalline silicon sheets and higher efficiency solar cells can be obtained with seeded growth using seed orientations similar to the afore mentioned dominant grain structure.

6585 **Unifying view of transient responses for determining lifetime and surface recombination velocity in silicon diodes and back-surface-field solar cells, with application to experimental short-circuit-current decay.** Jung, T.W.; Lindholm, F.A. (Department of Electrical Engineering, Univ. of Florida, Gainesville, FL). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Electron Devices;* **ED-31**: No. 5, 588-595(May 1984).

Two main results are presented. The first deals with a simple method that determines the minority-carrier lifetime and the effective surface recombination velocity of the quasi-neutral base of silicon solar cells. The method requires the observation of only a single transient, and is amenable to automation for in-process monitoring in manufacturing. Distinct from many other methods in use, this method, which is called short-circuit current decay, avoids distortion in the observed transient and consequent inaccuracies that arise from the presence of mobile holes and electrons stored in the p-n junction spacecharge region at the initial instant of the transient. The second main result consists in a formulation of the relevant boundary-value problems that resembles that used in linear two-port network theory. This formulation enables comparisons to be made among various contending methods for measuring material parameters of p-n junction devices, and enables the option of putting the description in the time domain in the form of an infinite series, although closedform solutions are also possible. The advantage of an infinite-series formulation is the possibility of identifying dominant relaxation times of the transient, leading thereby to simplified descriptions. By outlining the derivation of open-circuit-voltage decay and junction-current recovery from this two-port formulation, we systematically compare these methods with the short-circuit-current decay method that is emphasized here. Small-signal admittance measurement methods also emerge as special cases of the two-port formulation, as is discussed briefly.

6586 **Minority-carrier lifetime measurements on silicon solar cells using Isc and Voc transient decay.** Rose, B.H. (Sandia National Laboratories, Albuquerque, NM). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Electron Devices;* **ED-31**: No. 5, 559-565(May 1984).

Measurements of the transient decay of short-circuit current and open-circuit voltage of solar cells provide sufficient information, in principle, to determine both the effective back-surface recombination velocity S and the base minority-carrier lifetime /tau/. The practical use of the method is illustrated by an example, and the technique is applied to a variety of cells. Analysis of the effect of different cell thickness on the measurement is included. Finally, some limitations, both fundamental and experimental, are discussed.

6587 **High-efficiency ion-implanted silicon solar cells.** Spitzer, M.B.; Tobin, S.P. (Spire Corporation, Bedford, MA). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Electron Devices;* **ED-31**: No. 5, 546-550(May 1984).

The development of solar cells with AM1 coversion efficiency of 18 percent is reported. The cells comprise an $n^+$-p-$p^+$ structure fabricated from float zone silicon having resistivity of 0.3 Ω cm. The $n^+$ and $p^+$ regions are formed by low energy ion implantation and thermal annealing. An important feature of cell fabrication is the growth of $SiO_2$ passivation for reduction of surface recombination velocity. Details of both cell fabrication and testing are reported.

6588 **Cadmium telluride films and solar cells.** Bube, R.H.; Fahrenbruch, A.L. (Department of Materials Science and Engineering, Stanford Univ., Stanford, CA). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Electron Devices;* **ED-31**: No. 5, 528-538(May 1984).

CdTe thin films for solar cell applications have been deposited by close-spaced vapor transport and by hot-wall vacuum evaporation. As-deposited films are p-type with hole densities that increase to values of 1 X $10^{16}$ $cm^{-3}$ with increasing substrate temperature. A variety of experimental results can be interpreted either in terms of doping by native defects such as cadmium vacancies or doping by diffusion from the graphite substrate, with evidence for self-compensation. Many CdS/CdTe/graphite solar cells have been prepared by vacuum evaporation of CdS onto thin-film CdTe, which have low values of J /SUB o/ about $10^{-9}$ $A/cm^2$ and high values of J /SUB sc/ about 17 $mA/cm^2$. The open-circuit voltage is low at 0.48 V for CdS deposition at 300°C, but increases with decreasing CdS deposition temperature. The highest efficiency prepared to date is 6.4 percent. The efficiency is limited at present by the fill factor, associated with a total series resistivity in the light of the order of 10 $Ω-cm^2$. Supporting research on low-resistance contacts to p-type CdTe, grain boundary properties and passivation in p-type CdTe bicrystals and thin films, and high-resolution transmission electron microscopy of junction interfaces is briefly described.

6589 **Photovoltaic advanced research and development program in the United States.** Stone, J.L.; Ritchie, D.W.; Surek, T.; Witt, C.E. (Solar Energy Research Inst., Golden, CO). pp 628-637 of Photovoltaic solar energy conference. Dordrecht, Netherlands; D. Reidel Publishing Company (1982). (CONF-820555—).

From 4. photovoltaic solar energy conference; Stresa, Italy (10 May 1982).

## 1406 Photovoltaic Power Systems

*REFER ALSO TO CITATION(S) 1406006569, 6579, 7032*

6590 **(BDM/A—84-318-TR) Commercial application of a photovoltaic concentrator system lessons learned. Final report.** DiBello, E.G.; Reynolds, T.O.; Lambarski, T.J. (BDM Corp., Albuquerque, NM (USA)). 16 Oct 1984. Contract AC04-79ET20625. 36p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85002990.

The principal conclusion of the project is that large aperture linear parabolic troughs are not cost-effective for PV applications. Ground mount installations should be given consideration over roof mount systems if land space permits. The higher design costs and installation costs associated with roof installation make it less desirable. Roof structures should be carefully evaluated. In this case, the structure was not as strong as early estimates indicated, particularly in torsion. High thermal conductivity and electrical resistivity design parameters make PV module design very complex. Conductivity and resistivity are not the only material design constraints. Material selection analysis must also account for ultraviolet stabili-

ty, resistance to other than ultraviolet weathering, and compatibility of thermal expansion properties between materials. The intercept factor as well as the collector design ability to maintain the intercept factor must be carefully examined during the selection process. Non-uniformity of illumination may severely effect power output due to diode by-passing of poorly illuminated cells. The linearity of the focal beam and the collector structural integrity to maintain a linear focus are extremely important selection considerations. In the case of the CAPVC system, wind-up in the torque tube has produced a non-linear focal beam making accurate focus and total illumination of the receiver tube impossible.

6591 **(PNL-SA—12711) Appliance use in photovoltaic-powered residences.** Watts, R.L. (Pacific Northwest Lab., Richland, WA (USA)). Nov 1984. Contract AC06-76RL01830. 17p. (CONF-841179—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003638.

From Photovoltaics--research to reality 2 conference; San Diego, CA, USA (5 Nov 1984).

The selection of appliances and photovoltaic systems for a photovoltaic-powered residence is discussed. New appliances and systems spurred specifically by the growth of sales of photovoltaic modules include a variety of refrigerators for photovoltaic-powered homes, prepackaged home electric systems with photovoltaic modules, batteries, and photovoltaic-compatible appliances, and improved inverters. Power requirements for photovoltaic systems powering various kinds of electrical loads, both dc and ac, are summarized. (LEW)

6592 **Subsystem engineering and development of grid-connected photovoltaic systems.** Burgess, E.L.; Post, H.N.; Key, T.S. (Sandia National Lab., Albuquerque, NM). pp 238-247 of Photovoltaic solar energy conference. Dordrecht, Netherlands; D. Reidel Publishing Company (1982). (CONF-820555—).

From 4. photovoltaic solar energy conference; Stresa, Italy (10 May 1982).

The results of testing full scale subsystems for photovoltaic modules which generate power for grid interconnection are summarized. The trials were performed at Sandia Labs and covered the structures, foundations, field wiring, electrical subsystem protection, site preparation, and the power conditioning equipment. The goal was to characterize potential cost-reduction measures that would aid in making the solar cell systems competitive with grid-supplied power from conventional energy sources. Most data is from flat plate arrays, which were found to have similar designs, indicating that standardized production is possible. Recommendations are provided for mounting the cells in retrofits and new installations, and innovative wiring is suggested as a means to eliminating costly junction boxes. Totally integrated, modular field arrays which have encorporated the design recommendations are described. Production of systems with 10 pct efficiency at a subsystem cost of $0.77/Wp is predicted. 14 references.

6593 **Low cost modular designs for photovoltaic array fields.** Post, H.N.; Carmichael, D.C.; Castle, J.A. (Sandia National Lab., Albuquerque, NM). pp 275-279 of Photovoltaic solar energy conference. Dordrecht, Netherlands; D. Reidel Publishing Company (1982). (CONF-820555—).

From 4. photovoltaic solar energy conference; Stresa, Italy (10 May 1982).

Two balance-of-system (BOS) designs for photovoltaic module array support structures were designed for minimized cost. The baseline design comprised a field operating voltage of 400 Vdc, compliance with codes and safety requirements, a 10 pct module efficiency, and near-term use. The designs for similar, 2 x 4 ft modules, include either treated wood beams or concrete curbs, lightweight steel angle structures, either crimp-spliced pigtail or folded daisy chain with quick-disconnect connectors,and direct-burial cabling. Modular building blocks of one or two rows of mounted modules make up the arrays. The wood and concrete footing designs are projected to cost $51.93 and $62.92/sq m, respectively, if installed in 1982/1983 in low-production quantities. Project engineering costs are lowered by the use of standardized designs and components.

## 1407 Solar Thermal Power Systems

6594 **(DOE/DR/00789—T4) Control of large collector arrays: the SSPS experience. SSPS technical report No. 4/84.** Carmona, R.; Martin, J.G. (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V., Koeln (Germany, F.R.)). 1984. Contract AC04-76DR00789. 44p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85001461.

Experience gained in the control of the distributed collector fields at the IEA Small Solar Power Systems project may be of value in the design of control systems for future large arrays. This paper reports on the project experience with analog and digital systems; it gives details on the improvements that have already been made and reports on the lessons learned. A priority item in this year's efforts on site is the evaluation of the potential for fully automatic operation, with a suitable control algorithm, of a reliable collector array. This paper presents preliminary results from dynamic models of the fields in terms of lumped and distributed parameters, and outlines work in progress on adaptive controls.

6595 **(DOE/DR/00789—T5) SSPS-DCS plant performance, The Stair-Step. SSPS technical report No. 5/84.** Wattiez, P.; Martin, J.G.; Andersson, M. (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V., Koeln (Germany, F.R.)). 1984. Contract AC04-76DR00789. 48p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85001462.

This paper presents the performance data for the IEA/Small Solar Power Systems - Distributed Collector System (SSPS-DCS) for 1983. The analysis of plant performance covers the main subsystems from the collector field to the electric power generation system.

6596 **(DOE/DR/00789—T9) SSPS-CRS Advanced Sodium Receiver: construction experience report.** Hansen, J. (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V., Koeln (Germany, F.R.)). Sep 1984. Contract AC04-76DR00789. 63p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85000825.

The Advanced Sodium Receiver (ASR) is intended to explore the potential of sodium as a heat transfer medium. The principal objectives of the work reported are to test the behavior of the ASR for at least six months and to enable the central receiver plant of the SSPS project to run at higher heat fluxes and/or higher material and sodium temperatures. The experiences from the design, manufacturing, assembling, and acceptance testing of the ASR are reported. (LEW)

6597 **(DOE/SF/10501—061) 10-MWe solar thermal central receiver pilot plant: safety plan.** Heard, S.E. (Southern California Edison Co., Los Angeles (USA)). Nov 1982. Contract FC03-77SF10501. 8p. (STMPO—539). NTIS, PC A02. File Number DE84017037.

This is a supplement to the Southern California Edison Company Accident Prevention Manual (APM) and identifies Safe Work Practices for Solar One unique parts of the plant. The information is specific to the design of the Solar One Facility. Accident Prevention Rules and Safe Work Practices specified in the APM are applicable to the more traditional steam generation and electrical generation portions of this plant.

6598 **(SAND—82-8179-Vol.1) Molten salt steam generator subsystem research experiment. Volume I. Phase 1 - Final report.** (Foster Wheeler Solar Development Corp., Livingston, NJ (USA)). Oct 1984. Contract AC04-76DP00789. 319p. NTIS, PC A14/MF A01; 1; GPO Dep. File Number DE85003778.

A study was conducted for Phase 1 of a two-phase project whose objectives were to develop a reliable, cost-effective molten salt steam generating subsystem for solar thermal plants, minimize uncertainty in capital, operating, and maintenance costs, and demonstrate the ability of molten salt to generate high-pressure, high-temperature steam. The Phase 1 study involved the conceptual design of molten salt steam generating subsystems for a nominal 100-MWe net stand-alone solar central receiver electric generating

plant, and a nominal 100-MWe net hybrid fossil-fueled electric power generating plant that is 50% repowered by a solar central receiver system. As part of Phase 1, a proposal was prepared for Phase 2, which involves the design, construction, testing and evaluation of a Subsystem Research Experiment of sufficient size to ensure successful operation of the full-size subsystem designed in Phase 1. Evaluation of several concepts resulted in the selection of a four-component (preheater, evaporator, superheater, reheater), natural circulation, vertically oriented, shell and tube (straight) heat exchanger arrangement. Thermal hydraulic analysis of the system included full and part load performance, circulation requirements, stability, and critical heat flux analysis. Flow-induced tube vibration, tube buckling, fatigue evaluation of tubesheet junctions, steady-state tubesheet analysis, and a simplified transient analysis were included in the structural analysis of the system. Operating modes and system dynamic response to load changes were identified. Auxiliary equipment, fabrication, erection, and maintenance requirements were also defined. Installed capital costs and a project schedule were prepared for each design.

6599 **(SAND—82-8179-Vol.2) Molten salt steam generator subsystem research experiment. Volume II. Appendices A through F. Phase 1 - Final report.** (Foster Wheeler Solar Development Corp., Livingston, NJ (USA)). Oct 1984. Contract AC04-76DR00789. 284p. NTIS, PC A13/MF A01; 1; GPO Dep. File Number DE85004409.

These appendices provide supporting information on the molten salt steam generator subsystem research experiment. The information includes: preheater/evaporator pinch-point temperature difference, steam generator subsystem requirements and specification, design analysis plan, shop/field fabrication/erection plan, technical proposal, and Phase 2 cost proposal. (LEW)

6600 **(SAND—84-1698) Some solar dish/heat engine design considerations.** Alvis, R.L. (Sandia National Labs., Albuquerque, NM (USA)). Nov 1984. Contract AC04-76DP00789. 17p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85003479.

Tradeoff decisions are an essential feature of solar dish/electric system design. The often competing characteristics of the various subsystems require careful analysis before a designer can create an optimal performance, minimal cost final product. Discussed here are design factors such as the dish concentration ratio as a function of operating temperature; the module performance characteristics of Brayton, Rankine, and Stirling heat engines; hybrid operation economics; optimum module size; and thermodynamic effects. It is shown that for heat engines operating at 1370°C or above, the dish concentration ratio needs to be at least 2000 and the optimum dish diameter is between 14 m and 19 m. High engine efficiency as a result of increased temperature is shown to be not always desirable for solar modules. The second-law thermodynamic results indicate single insolation reflection is desired over the use of terminal concentrators or multiple reflections.

6601 **(SAND—84-8188) Bibliography of Sandia National Laboratories solar central receiver reports.** Soderstrum, M.G. (Burns and McDonnell Engineering Co., Kansas City, MO (USA)). Nov 1984. Contract AC04-76DR00789. 186p. NTIS, PC A09/MF A01; GPO Dep. File Number DE85003268.

The 1973-1983 published reports of the technical information developed by the Sandia National Laboratories Solar Central Receiver Program are compiled into this bibliography. An abstract of each report is included. Reports are listed in numerical order by report number and an author index is appended.

6602 **Analysis and design of the "Solar One" thermal storage subsystem heat exchangers.** Weiner, F.R. (Rockwell International/Rocketdyne Division, Canoga Park, CA). *Journal of Solar Energy Engineering;* **106**: No. 3, 279-285(Aug 1984).

This paper describes the analysis and design of the five kinds of heat exchangers used in the thermal storage subsystem of the 10 MWe Solar Central Receiver Pilot Plant, now becoming more known as "Solar One". The paper discusses the practices and standards used in the designs of the heat exchangers, lists the heat exchanger design requirements, and discusses the process conditions. The design assumptions and constraints, the geometrical considerations, and the tradeoff studies that were conducted to optimize the designs are also discussed. A description of each heat exchanger reveals the final design solution. Novel and unique features of a power plant that must operate on a daily sun-cycle are identified.

6603 **Photovoltaic retrofit feasibility in the United States.** Jackson, J.L. (Sandia National Lab., Albuquerque, NM). pp 101-105 of Photovoltaic solar energy conference. Dordrecht, Netherlands; D. Reidel Publishing Company (1982). (CONF-820555—).

From 4. photovoltaic solar energy conference; Stresa, Italy (10 May 1982).

## 1408 Ocean Energy Systems

6604 **(SERI/TP—252-2331) Open-cycle ocean thermal energy conversion (OTEC) research: progress summary and a design study.** Penny, T.; Bharathan, D.; Althof, J.; Parsons, B. (Solar Energy Research Inst., Golden, CO (USA)). Aug 1984. Contract AC02-83CH10093. 13p. (CONF-841201—20). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85000504.

From ASME winter annual meeting; New Orleans, LA, USA (9 Dec 1984).

In 1980, the Westinghouse Corporation completed an extensive Claude open-cycle ocean thermal energy conversion (OC-OTEC) system design study. Since that time, the Solar Energy Research Institute (SERI) has produced concepts and data bases that have reduced the technical uncertainties associated with the evaporator and condenser design and performance, seawater sorption kinetics and gas removal systems, low pressure turbine design with novel materials, and low cost system containment and structural design. This paper describes an integrated system design case study using the improved data base and summarizes an assessment of the relative thermodynamic performance of advanced technologies, drawing parallels with Claude's early work in the 1930s. Projections from these latest advances imply that OC-OTEC systems can be cost effective in sizes less than 10 MW/sub e/. Analyzing the research needs for OC-OTEC systems reveals that an experimental facility integrating all essential components of a system is required. This paper describes a facility for conducting advanced research and verifying cycle feasibility in terms of performance, reliability, and cost. The thermodynamic performance of this integrated design is projected using an analytical system model incorporating the highly coupled component interactions.

6605 **(SERI/TP—252-2332) Experimental study of steam condensation on water in countercurrent flow in presence of inert gases.** Bharathan, D.; Althof, J. (Solar Energy Research Inst., Golden, CO (USA)). Aug 1984. Contract AC02-83CH10093. 13p. (CONF-841201—18). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE84013028.

From ASME winter annual meeting; New Orleans, LA, USA (9 Dec 1984).

Experimental results of investigating steam condensation on water in the presence of (noncondensable) inert gases at low temperatures and pressures relevant to open-cycle ocean thermal energy conversion (OTEC) systems are reported. Seven different condenser configurations were tested. The experimental data are correlated using a liquid flow fraction and a vent fraction to yield simple relationships of condenser performance over a wide range of test conditions. Performance maps and envelopes are provided for evaluating the relative merits of tested configurations. The height of transfer unit (HTU) for condensation ranges from 0.2 to 0.3 m among the various condenser geometries. Also reported are the pressure-loss coefficients for all the tested geometries.

6606 **Design of the near shore seawater systems for an OTEC expanded test facility.** Genens, L.; Stevens, H. pp 141-144 of Proceedings of the third international offshore mechanics and arctic engineering symposium. Volume II. Chung, J.S. (ed.). New York, NY, USA; American Society of Mechanical Engineers ([1984]).

A design for expanded test facilities at the Seacoast Test Facility site, Kealhole Point, Hawaii is described. Specific effort has been placed on the design of the near-shore/on-shore seawater systems. The seawater systems consist of a warm-water supply, a cold-water supply, a mixed discharge, and a land-based pumping station. Test facilities are planned that will utilize this thermal energy resource. This resource consists nominally of 1600 kg/s of cold water and 4200 kg/s of warm surface water, which will be used to support heat-exchanger and system tests and, with a turbine added, could produce a net power for the validation of closed- and open-cycle models now in planning at ANL and the Solar Energy Research Institute (SERI).

## 1409 Solar Thermal Utilization

*REFER ALSO TO CITATION(S) 1409006382, 6656, 6658, 6997, 7010*

6607 **(AD-A—144294/6) Solar thermal propulsion: an investigation of solar radiation absorption in a working fluid. Final report 9 January-15 April 1984.** Perry, F.J. (Air Force Rocket Propulsion Lab., Edwards AFB, CA (USA)). Jun 1984. 76p. (AFRPL-TR—84-032). NTIS, PC A05/MF A01.

The objective of this solar thermal propulsion study was to examine the state of the science of direct absorption of solar radiation into a working fluid for use in propulsive devices. In particular, the absorption characteristics of alkali seeded hydrogen gas were investigated. Because of obvious parallels, the laser propulsion literature was reviewed as well as the solar propulsion literature. The investigation also covered peripheral areas such as aerodynamic windows and alkali/hydrogen mixing techniques. This report presents the important details from the existing information with an extensive list of references included. Recommendations for future theoretical and experimental Air Force research were made based upon the data uncovered. Topics addressed include: Absorption Coefficients, Solar Radiation Absorption, Hydrogen-Alkali Absorption, Laser Propulsion, and Aerodynamic Windows.

6608 **(DOE/CE—0089) Passive solar heating.** (USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC). Jun 1984. 7p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85003503.

The three means of heat transfer, several passive solar heating techniques, and the four basic classifications of solar heating techniques are described in this leaflet. Some figures are given for the ratio of thermal mass to glazing. A list of books and pamphlets is included. (MHR)

6609 **(DOE/CE—0095) Passive cooling.** (USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC). Sep 1984. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003197.

Design considerations for new construction are described. Various cooling options which can be used for homes being planned, or for ones that have already been constructed are discussed. Weatherization, natural shading methods, shading devices, ventilation and other methods are included. (MHR)

6610 **(DOE/CE—0096) Converting a home to solar heat.** (USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC). Jun 1984. 4p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85003198.

Factors that affect the feasibility of any solar retrofit are described. Various aspects of active and passive solar heating systems are presented. (MHR)

6611 **(DOE/CS/30159—T4) Frost-free greenhouse: design and operation considrations for commercial and community management.** (Western Sun, Portland, OR (USA)). Mar 1982. Contract AC02-79CS30159. 109p. NTIS MF A01; 2; GPO Dep. File Number DE85000451.

The following design topics are discussed: a frost-free greenhouse from a kit greenhouse, solving the energy problem, the greenhouse envelope, frost-free thermal analysis, no-cost energy conservation measures, standard insulating materials and techniques, thermal mass, ventilation and cooling systems, heat retention blankets for night insulation, and warm-air destratification. The following operation topics are included: inside the frost-free greenhouse, cost consideration, vegetable crops, ornamental crops, cut flowers, environment and layout, solar specific horticulture, potted plants, pest assault, suppliers of predators and parasites, case studies, and bibliographies. (MHR)

6612 **(DOE/CS/30343—T1) [Passive Solar Commercial Buildings Program]. Final technical report.** Kieffer, B.D. (North Design, Madison, WI (USA)). 28 Jun 1984. Contract FC02-80CS30343. 210p. NTIS, PC A10. File Number DE84017411.

The addition of a sunspace to a commercial building which was oriented along a north-south axis is described. Light shelves are used for daylighting the interior of the building. The sunspace also added much needed floorspace. Performance data and analysis are included. (MHR)

6613 **(DOE/CS/30393—T1) SOLCAN: the Solar Consumer Assurance Network. Final report.** (Western Solar Utilization Network, Portland, OR (USA)). 15 Mar 1982. Contract FG02-77CS30393. 129p. NTIS, PC A07. File Number DE85001308.

The SOLCAN strategy used in the development of the four Model State concepts is presented. Model state programs to encourage on-site solar use developed for Arizona, California, Hawaii, and Nevada are presented. Information on the SOLCAN Intertie Conference is included. (MHR)

6614 **(DOE/CS/34976—T1) DOE active solar cooling R and D projects. Final report.** Allen, R.W.; Anand, D.K. (Maryland Univ., College Park (USA). Dept. of Mechanical Engineering). 1979. Contract AS05-76CS34976. 31p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85003299.

A general state-of-the-art in solar cooling and the specific work performed at the University of Maryland are summarized. The technical achievements pertaining to component modeling, cooling system performance predictions, simplified design methods and validation studies are reviewed.

6615 **(DOE/ET/20642—T1) SOLERAS program. Engineering field test of a solar cooling system. Final report.** (United Technologies Research Center, East Hartford, CT (USA)). May 1983. Contract FC02-80ET20642. 194p. (R—82-955027-2). NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE85000732.

A solar-powered air conditioning system was designed, constructed, and installed at a Phoenix, Arizona site whose climatic conditions approximate those of Saudi Arabia. The nominal 18 ton capacity Rankine cycle chiller system with hot and cold storage and conventional fan/coil delivery units was operated for two cooling seasons and met its design objectives.

6616 **(DOE/R4/10227—T1) Comparison of energy use of a solar greenhouse with that of a conventional greenhouse.** Withers, J.D. Jr. (Withers (John D., Jr.), Woodville, MS (USA)). [1984]. Contract FG44-80R410227. 25p. NTIS, PC A02. File Number DE85000219.

This solar greenhouse cost approximately the same to construct as the best conventional greenhouses but uses only about 1/3 as much energy for operation. It can be built and operated by anyone who can build and operate a conventional greenhouse. It can be used to grow the same plants as the conventional greenhouse with the possible exception of those plants requiring the highest light intensity.

6617 **(DOE/R4/10463—T1) Performance of three breadbox solar water heaters in central Florida.** Burch, J.B. (Burch (Jefferson B.), Oakland, FL (USA)). Fal 1983. Contract FG44-81R410463. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85000635.

This project investigated three breadbox solar waterheaters in Central Florida. Temperature distributions that occur as the breadbox tank absorbs solar energy are throughly documented. Thermal stratification in breadbox heaters is dramatic during sunny

hours as the tank collects useful energy. Performance of breadbox water heaters is hindered by their small surface area to volume ratio. For instance, the typical Florida domestic solar water heating system uses 40 ft² collector for an 84 gallon tank. Typical breadbox designs provide roughly half this amount for similar storage volumes. In Florida's mild climate, nocturnal insulation can be considered optional for nine months of the year. However, winter performance without an insulation mechanism is very poor with 6 am tank temperatures below 80°F. This contrasts sharply with results from a nominal 1.5″ expanded polystyrene shutter system 6 am tank top temperatures of 107°F.

6618 **(EUR—7710) Critical appraisal of monitoring procedures in solar houses. Volume 1. Analysis and recommendations. Volume 2. Case studies.** Turrent, D.; Whittaker, C.; Lush, D. (Commission of the European Communities, Luxembourg). 1983. 210p. (EUR—7710-EN). NTIS, PC E09/MF E09.

The main objective of this study has been to investigate the monitoring arrangements in existing solar heated houses, and to recommend a course of action for any future field trials sponsored by the European Commission. The report is presented in two volumes. Volume I contains an analysis of the information collected during the survey period, and the study's main recommendations. The analysis covers two principal areas: firstly, the physical characteristics and objectives of individual projects and the identification of key factors affecting system performance; and secondly, methods of instrumentation, data acquisition and analysis, and reporting. Volume II contains Case Studies on a total of twenty four monitored solar heating projects, located in the EEC and Sweden.

6619 **(NP—5900016) Investigation of the performance of solar heating and cooling systems. Simulation program validation using domestic hot water system data. Task 1.** Jorgensen, O. (Danmarks Tekniske Hoejskole, Lyngby. Thermal Insulation Lab.). Aug 1982. 120p. NTIS (US Sales Only), PC A06/MF A01. File Number DE85900016.

Within Task I of the IEA Solar Heating and Cooling Programme, simulation methods for predicting the thermal performance of active solar systems have been evaluated by model-to-model comparisons and comparisons with measured performance data. The present report describes the final activity within the Task by which the predictions of the simulation models were compared to measured data from four domestic hot water systems. Ten different research groups employing a total of seven computer codes participated in this cooperative effort. The model evaluation was extended by a parameter sensitivity analysis to help further define the limits of applicability of the models. Both activities were undertaken in two rounds leading to excellent agreement in the case of validation and fine agreement in the parameter sensitivity analysis. The report describes the progress of the work and the steps taken to achieve the satisfactory end results.

6620 **(NP—5900018) Central solar heating plants with seasonal storage: basic design data for the heat distribution system.** Bruce, T.; Lindeberg, L.; Roslund, S. (Soedertaelje Energy Supply Authority (Sweden); Aaf, Energikonsult, Stockholm (Sweden)). Oct 1982. 107p. NTIS (US Sales Only), PC A06/MF A01. File Number DE85900018.

This report deals with the distribution of energy by means of hot water. The aim is to provide basic design data for the distribution system interconnecting solar collectors, seasonal heat storage and consumers in Central Solar Heating Plants with Seasonal Storage (CSHPSS). Thus the report reviews the present situation of the district heating technology in participating countries, discusses basic assumptions for the heat distribution in a CSHPSS and presents a collection of basic cost data.

6621 **(NP—5900019) Central solar heating plants with seasonal storage. Cost data and cost equations for heat storage concepts. Task VII.** Hadorn, J.C.; Chuard, P. (Sorane SA, Lausanne (Switzerland); International Energy Agency, 75 - Paris (France). Programme to Develop and Test Solar Heating and Cooling Systems). Jun 1983. 91p. NTIS (US Sales Only), PC A05/MF A01. File Number DE85900019.

This report deals with the cost of the seasonal heat storage concepts considered in the IEA Task VII for Central Solar Heating Plants with Seasonal Storage (CSHPSS). The aim was to gather basic cost data for heat storage from the participating countries, and to give cost equations for the optimization process of the CSHPSS with the MINSUN program, to be used as a common tool in Task VII. The report gathers the cost data given by the participating countries, compares the given cost for each storage type, and presents the cost equations suitable to MINSUN, developed by the Subtask 1c Lead Country.

6622 **(NP—5900061) Central solar heating plants with seasonal storage. Heat storage systems: concepts, engineering data and compilation of projects.** Chuard, P.; Hadorn, J.C. (Sorane SA, Lausanne (Switzerland); International Energy Agency, 75 - Paris (France). Programme to Develop and Test Solar Heating and Cooling Systems). Jun 1983. 188p. NTIS (US Sales Only), PC A09/MF A01. File Number DE85900061.

This report deals with the seasonal storage of energy by means of sensible heat. The aim is to present basic engineering information for the different heat storage concepts considered in the IEA Task VII for Central Solar Heating Plants Seasonal Storage (CSHPSS). The report describes briefly the heat storage concepts and their applicability, reviews the present situation of the heat storage technology in participating countries, and presents a short technical compilation of some interesting projects in participating countries.

6623 **(NP—5900102) Central solar heating plants with seasonal storage: tools for design and analysis, Task VII.** Chant, V.G.; Biggs, R.C. (Hickling (James F.) Management Consultants Ltd., Ottawa, Ontario (Canada); National Research Council of Canada, Ottawa, Ontario). Dec 1983. 165p. NTIS (US Sales Only), PC A08/MF A01. File Number DE85900102.

The objectives were: to develop procedures and analytic tools for studying system feasibility and for evaluation, and to recommend specific systems analysis procedures and tools for use in Sub-Task I(e), Site-Specific Preliminary Design, and Phase II of Task VII. The approach adopted was to select, modify and further develop two analytic tools as design aids for CSHPSS and to examine the appropriateness of these tools by undertaking application case studies. Although the CSHPSS configurations were limited by the lack of complete flexibility of the design tools, applications over a range of system sizes, collector types, weather conditions and operational schemes can be examined. It was concluded that the MINSUN program, in particular, was a useful tool for understanding the thermal and economic characteristics of many CSHPSS configurations and over a broad size range.

6624 **(NP—5900129) Investigation of the performance of solar heating and cooling systems: modelling and simulation, Task I.** Joergensen, O. (Danmarks Tekniske Hoejskole, Lyngby. Thermal Insulation Lab.). Oct 1979. 269p. NTIS (US Sales Only), MF A01. File Number DE85900129.

Within the IEA program to develop and test solar heating and cooling systems a comparison of simulation methods for predicting the performance of solar heating systems has been coordinated. The methods which were developed within IEA-countries participating in this work are presented and compared in this report. The methods have been used to predict the performance of both a liquid and an air based system. Hourly simulations have been carried out on weather data from three different locations in the world. In this report the predictions are compared on an hourly, a monthly and a yearly basis and show good agreement. Possible reasons for differences are sought, and a series of collector efficiency curves calculated by the different programs is therefore included in the report. The report opens with a chapter on the general aspects of solar systems modelling.

6625 **(PB—84-232750) Prediction of long term monthly mean daily solar gains through vertical single and double clear glazing at sites distributed throughout the UK (United Kingdom).** Rodgers, G.G.; Page, J.K.; Colquhoun, I.D.; Thompson, J.L. (Sheffield Univ. (UK). Dept. of Building Science). Jul 1982. 47p. (BS—66). NTIS, PC E04/MF E04.

The objective of this study was to develop a suitable simple mathematical model for predicting the monthly mean daily solar gains through vertical single and double glazing with any orientation for sites in the U.K. Such predictions of radiative heat gains through windows were required, for example, for incorporation in the University of Sheffield, Department of Building Science interactive computer program ENGY which estimates the average heating energy requirements of buildings located in any of the seventeen Department of Energy standard degree day regions, taking account of both external and internal heat gains. Solar gain data for windows were estimated for one site within each region and also additionally for three major U.K. meteorological stations, Eskdalemuir, Lerwick and Aberporth (St. Ann's Head) for which very full radiation observations were available. The method was developed from a detailed model for predicting mean monthly hourly and daily solar gains through vertical glazing of any azimuth from an input of monthly mean daily sunshine which had previously been developed and checked for Kew as part of a research project supported by S.E.R.C. So it was logical that this model should be used as the basis of the predictive method for other U.K. sites.

6626 **(PB—84-232834) Systematic design assessment techniques for solar buildings.** Page, J.K.; Rodgers, G.G.; Souster, C.G. (Sheffield Univ. (UK). Dept. of Building Science). Mar 1979. 76p. (BS—48). NTIS, PC E05/MF E05.

Presented at the Royal Society Discussion Meeting on Solar Energy, London, November 1978.

Solar building design involves the systematic study of complex inter-relationships between the temporal patterns of solar energy supply and the temporal patterns of energy use within the building. Variations in weather exercise a dominating role. Peak energy demands and solar supply tend to be anti-phase. However, the temporal matches between such dynamic inputs and outputs can be improved by the introduction of appropriate thermal storage either making use of the building fabric itself or alternatively introducing special thermal stores as capacitance phase regulators. Detailed thermal design assessment is thus complex. A team led by J.K. Page in the Department of Building Science, University of Sheffield have been studying how to automate the complex climatological design assessment of passive and active solar buildings using interactive computer-aided design techniques with associated graphics. This paper describes the various approaches developed for the detailed modelling of the relevant climatic input variables.

6627 **Solar-powered turbocompressor heat pump system.** Landerman, A.M.; Anderson, T.J.; Biancardi, F.; Kepler, C.E.; Meader, M.D.; Melikian, G.; Sitler, J.W. (to Dept. of Energy). US Patent 4,464,908. 14 Aug 1984. Filed date 12 Aug 1982. vp.

The turbocompressor comprises a power turbine and a compressor turbine having respective rotors on a common shaft, rotatably supported by bearings. A first working fluid is supplied by a power loop and is expanded in the turbine. A second working fluid is compressed in the turbine and is circulated in a heat pump loop. A lubricant is mixed with the second working fluid but is excluded from the first working fluid. Bearings are cooled and lubricated by a system which circulates the second working fluid and the intermixed lubricant through the bearings. Such system includes a pump, a thermostatic expansion valve for expanding the working fluid into the space between the bearings, and a return conduit system for withdrawing the expanded working fluid after it passes through the bearings and for returning the working fluid to the evaporator. A shaft seal excludes the lubricant from the power turbine. The power loop includes a float operable by liquid working fluid in the condenser for controlling a recirculation valve so as to maintain a minimum liquid level in the condenser, while causing a feed pump to pump most of the working fluid into the vapor generator. The heat pump compressor loop includes a float in the condenser for operating an expansion valve to maintain a minimum liquid working fluid level in the condenser while causing most of the working fluid to be expanded into the evaporator.

6628 **Simple heat exchange factors for steamproducing solar systems.** Gee, R.C. (Industrial Solar Technology Denver, CO). *Journal of Solar Energy Engineering;* **106**: No. 3, 364-366(Aug 1984).

The use of energy by industry accounts for over one-third of the total U.S. energy use. The largest share of this energy is used in the form of low-pressure saturated steam. Solar IPH systems that have been used to generate steam have been of two principal configurations: unfired boiler systems and flash steam systems. The thermal performance of these systems depends in part on the interaction between the solar collectors and the unfired boiler or flash tank. Two simple performance modifiers are derived which account for the interaction and quantify the overall effect on steam system performance. The two heat exchange factors depend only on fixed, known quantities and are independent of weather characteristics and collector operating temperatures, which change during system operation. These steam system heat exchange factor derived by deWinter, commonly referred to as F /SUB x/ , for double-loop water heating systems, that use a heat exchanger between the solar collectors and the water storage tank.

6629 **Second law analysis of solar powered absorption cooling cycles and systems.** Anand, D.K.; Kennish, W.J.; Lindler, K.W.; Schweitzer, S. (University of Maryland, College Park, MD). *Journal of Solar Energy Engineering;* **106**: No. 3, 291-298(Aug 1984).

The Second Law of Thermodynamics is used to analyze solar powered absorption cooling cycles and systems. Irreversibility is used as a figure of merit for components and cycles. The irreversibility of individual components is determined for several solar-powered absorption cycles and systems. The understanding of the causes of these irreversibilities identifies the areas of possible cycle and system improvements.

6630 **Open-cycle desiccant air conditioning as an alternative to vapor compression cooling in residential applications.** Jurinak, J.J.; Beckman, W.A.; Mitchell, J.W. (Solar Energy Laboratory, University of Wisconsin-Madison, Madison, WI). *Journal of Solar Energy Engineering;* **106**: No. 3, 252-260(Aug 1984).

The performance of open-cycle desiccant air conditioners for residential applications is evaluated. The performance of these systems is compared to that of vapor compression air conditioners on the basis of primary energy use and cost. Systems with improved dehumidifiers can achieve seasonal COP's on the order of 1.1. These systems, when coupled with a solar energy system to supply regeneration energy, are significantly better than conventional air conditioners on a primary energy basis, but are not presently cost-competitive.

6631 **A solar explosion.** Baccei, B.C. (Solar Energy Research Institute, 1617 Cole Boulevard, Golden, Colorado 80401). pp 17-19 of Advances in energy technology. Sauer, H.J.; Hegler, B.E. Rolla, MO, USA; Univ. of Missouri-Rolla (1981). (CONF-811137—).

From University of Missouri Department of Natural Resources conference on energy; Rolla, MO, USA (6 Nov 1981).

The Solar Energy Research Institute (SERI) and the Department of Energy (DOE) Passive Solar Manufactured Buildings and Solar Home Builders Programs are developing much needed cost and performance data on solar buildings produced by large-volume home builders. These programs also serve as a model on how government can work effectively with industry.

6632 **An evaluation of the Los Alamos scientific laboratory's residential passive solar methods applied to small commercial buildings.** Arnoth, D.E.; Architecture, M. (School of Architecture and Planning, University of New Mexico, Albuquerque, New Mexico). pp 47-56 of Advances in energy technology. Sauer, H.J.; Hegler, B.E. Rolla, MO, USA; Univ. of Missouri-Rolla (1981). (CONF-811137—).

From University of Missouri Department of Natural Resources conference on energy; Rolla, MO, USA (6 Nov 1981).

This study evaluates the applicability of the Analysis Methods for Passive Solar Heating Systems, developed by Los Alamos Scientific Laboratory, to small commercial buildings (less than 5,000 square feet). The performances of three passive solar commercial buildings are analyzed. Comparisons are made between the predicted and actual energy consumption patterns. There was a

close correlation (less than 7% difference) between the predicted yearly and the actual yearly solar savings fraction when the internal heat generation and thermostat schedule were properly accounted for. The evaluation process diagramed in this study will be of use to others validating passive solar methods applied to commercial or residential buildings. From this analysis, implications are drawn for future use of these calculation procedures by energy conscious designers of commercial buildings.

6633 **Energy savings obtainable through passive solar techniques.** Balcomb, J.D. (Los Alamos Scientific Laboratory, Los Alamos, NM). pp 277-288 of Building energy management-Conventional and solar approaches. De Oliveira, F.E. Oxford, England; Pergamon Press (1981). (CONF-800524—).

From International congress on building energy management; Povoa de Varzim, Portugal (12 May 1980).

A passive solar energy system is one in which the thermal energy flow is by natural means, that is by radiation, conduction, or natural convection. The purpose of the paper is to provide a survey of passive solar heating experience, especially in the U.S. Design approaches are reviewed and examples shown. Misconceptions are discussed. Advantages are listed. The Los Alamos program of performance simulation and evaluation is described and a simplified method of performance estimation is outlined.

6634 **Human comfort and auxiliary control considerations in passive solar structures.** Kammerud, R.; Anderson, B. (Passive Solar Group, Lawrence Berkeley Laboratory, Berkeley, CA). pp 241-250 of Building energy management-Conventional and solar approaches. De Oliveica, F.E. Oxford, England; Pergamon Press (1981). (CONF-800524—).

From International congress on building energy management; Povoa de Varzim, Portugal (12 May 1980).

Energy consumption and human comfort implications of various passive solar and energy conservation strategies are investigated for single-family, one-story, slab-on-grade residences in Albuquerque, NM and Washington, DC. The building energy analysis computer program BLAST is used to perform annual dynamic heating and cooling load calculations for a building in which the glazing area, glazing location, and thermal mass are varied systematically. The impacts on building performance of forced-flow ventilative cooling and nighttime and weekday thermostat setpoint adjustments are investigated. The results indicate that the annual heating and cooling loads are highly sensitive to glazing area, glazing location, and thermostatic controls. Annual cooling loads are substantially reduced by increased thermal mass in the walls. In contrast, annual heating loads are fairly insensitive to increased thermal mass in the walls, unless very large areas of south glazing are involved. BLAST calculates the air temperatures (T /SUB a/ ) and mean radiant temperatures (T /SUB mr/ ) in each zone for every hour of the year; a weighted average of T /SUB a/ and T /SUB mr/ is used to evaluate comfort conditions under various circumstances.

6635 **Bruce Hunn residence as simulated by the DEROB system.** Northrup, D.O.; Arumi-Noe, F. (Univ. of Texas, Austin). *ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) Transactions;* **86**: No. 2, vp(1980).

The DEROB System configuration is described, using as an example the simulation of the Bruce Hunn Residence in Los Alamos, NM. DEROB is a system of computer programs developed originally as a research and teaching tool. Eight validation studies have been successfully completed. In addition to the results reported in this article, DEROB has been successfully validated against data collected in a full-scale hybrid residence as well as test rooms built by the Los Alamos Scientific Laboratories (LASL). The results presented here are part of the ongoing effort to validate the accuracy of the DEROB System using different buildings and passive systems configurations for which reliable data are available. The Bruce Hunn Residence is a medium sized home of approximately 214 $m^2$ which is equipped with a Trombe wall system. Using energy performance data supplied by the Los Alamos Scientific Laboratory (LASL), this simulation includes illustrations of the interactive data input by a DEROB peripheral program as well as the results obtained by intermediate steps of the simulation, including a basic description of the relevant algorithms.

## 1410 Solar Collectors And Concentrators

*REFER ALSO TO CITATION(S) 1410006590, 6601*

6636 **(DOE/CS/30599—T2) Development of mass-producible line-focus tracking concentrating solar collectors. Category 2: trackers.** Carlton, R.J. (Acurex Solar Corp., Mountain View, CA (USA)). Oct 1984. Contract FC04-80CS30599. 33p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85002673.

The design and construction of the third generation mass-producible tracker system for line-focus concentrating solar collectors has been completed and has performed well in testing and use at the Modular Industrial Solar Retrofit (MISR). The design incorporates high tracking accuracy and smart response to varying insolation and operational conditions, allows a low-cost tracking and control system, and provides high collector system performance. The tracker system consists of the tracker controller (a tracker head) and interconnecting cable. The tracker controller is in a single enclosure and employs a light band photodiode system as the primary tracking method. Other related elements not part of the tracker system itself are the drive motor, group control box, master controller and Solar Tracking Angle Reference. Key aspects of these elements are described herein to provide a complete description of the tracker function and its interactions. This report presents the tracker design requirements, the basic design and functional description, a detailed component description, and production planning comments.

6637 **(DOE/CS/34293—T2) Accelerated durability testing and evaluation of potential improvements of contings for solar absorbers. Final report.** Raghunathan, K.; Beatty, C.C.; Cotsworth, J.L. (Berry Solar Products, Edison, NJ (USA)). Oct 1982. Contract AC04-78CS34293. 19p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004411.

About one-hundred commercially available solar absorptive coatings, both selective and non-selective, were tested for durability by simultaneously exposing them in a collector box with a cover plate to seventy-eight temperature cycles between 450+35°F (232+20°C) and 200+25°F and to solar radiation of about 22,000 langleys. Changes in the absorptance and emittance values were measured. Some of the coatings were also exposed to additional solar radiation of 156,000 langleys obtained at DSET Laboratories, Inc. of Phoenix, Arizona in EMMA (Equatorial Mount with Mirrors for Acceleration) under 8:1 concentration. Under the relatively high temperatures (180° to 220°C) and conditions of the combined thermal cycling and exposures described, most of the selective coatings, except cobalt oxide, zinc oxide, AMA sputtered on aluminum and stainless steel, nickel electroplated on anodized aluminum and copper oxide, did not show significant deterioration in optical properties. Majority of the non-selective coatings did not show significant changes in optical properties, but they exhibited physical, visual and mechanical damage. It is the conclusion of this work that the preceding test procedures provided valuable information on the long term durability of the coatings. Commercial black chrome coatings exhibit black, blue and reddish hues, which are due to different agglomerate sizes consisting of differing chromium metal to oxide ratios. Absorptance values vary slightly with hue. The presence of the hues did not affect the durability of the coatings under the above test sequence. Smut on black chrome contains a higher amount of oxide and exhibits somewhat higher Absorptivity and Emissivity values.

6638 **(DOE/SF/11946—T1) Experimental study of direct in-situ generation of steam in a line focus solar collector. Final report.** Hurtado, P.; Kast, M. (Research Engineering Associates, Palo Alto, CA (USA)). 20 Sep 1984. Contract AC03-83SF11946. 74p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85000497.

This report summarizes the results of an investigation to experimentally determine the practicality of generating steam directly within the receiver tube of a parabolic trough solar collector. Iden-

tified in the literature as in-situ boiling, this system concept features nucleate boiling and two-phase flow within the receiver tube. This effort included a literature survey of past work, design of a proof-of-concept test, system operation under a range of steam delivery temperatures and qualities, and analysis of the results. The proof-of-concept test was performed using an existing 120 foot long row of collector installed in McKittrick, California.

6639 **(NBS-TN—1196) NBS solar collector durability/reliability test program. Final report.** Waksman, D.; Thomas, W.C.; Streed, E.R. (National Bureau of Standards, Washington, DC (USA)). Sep 1984. 151p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE85003489.

Efforts in the development of reliability/durability tests for solar collectors and their materials have been hampered by the lack of real time and accelerated degradation data that can be correlated with in use conditions. The focus of this report is on research undertaken at the National Bureau of Standards (NBS) to help generate the data required to develop methods for predicting the long term durability and reliability of flat-plate solar collectors and their materials. Eight different types of flat-plate solar collectors were exposed outdoors at four sites located in different climatic regions. Small scale cover and absorber materials coupon specimens consisting of samples taken from a collector of each of the eight types used and a number of additional materials were exposed concurrently with the full-size collectors. Periodic measurements were made of collector and materials performance as a function of outdoor exposure time. Indoor laboratory aging tests were conducted concurrently on specimens of the same materials to provide a basis for comparison with the outdoor exposure tests. The results obtained in this test program are presented. Recommendations are made regarding the use and limitations of performance measurements and environmental exposure tests for assessing the durability of solar collectors and absorber and cover materials.

6640 **(NBSIR—84-2887) Flame spread on combustible solar collector glazing materials. Final report.** Braun, E.; Allen, P.J. (National Bureau of Standards, Washington, DC (USA). Center for Fire Research). Jul 1984. Contract AI01-76PR06010. 62p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85002598.

The use of ASTM D635 and associated criteria as an evaluation method for solar collector glazings was investigated. Four materials commonly used in solar collector applications were evaluated by ASTM D635. Four other test methods were used to characterize the glazing materials as to ignition, flame spread, and heat release rate. These results were compared to large scale fire tests of these materials. Based on the large scale tests, it was found that ASTM D635 produced test results that were not consistent with those obtained from the large scale tests. Good agreement was found between the rank ordering of the large scale tests and heat release rate and ignition properties as measured in the cone calorimeter and modified ISO test.

6641 **(PB—84-232412) Model study of convective heat transfer from roof-mounted flat plate solar collectors.** Charlesworth, P.S. (Sheffield Univ. (UK). Dept. of Building Science). Aug 1983. 103p. (BS—75). NTIS, PC E06/MF E06.

The conversion of the sun's energy, which falls on the earth's surface as thermal radiation, into a usable form can be accomplished by a variety of techniques and systems, for example solar ponds, solar cookers and flat place collectors. It is with this last named device that the present study is concerned. The aim of the experiments, reported in this report, is to evaluate natural and forced convective heat transfer coefficients for a plate situated in various locations on a house roof. The dependence of these values not only with wind velocity but also with wind direction, roof pitch and plate position on the roof was also investigated.

6642 **(PB—84-232818) Review of data on wind loads on solar collectors.** Lee, B.E. (Sheffield Univ. (UK). Dept. of Building Science). Nov 1982. 54p. (BS—70). NTIS, PC E04/MF E04.

The purpose of this document is to present a survey of the available information concerning the derivation of wind loads on solar collectors. It is important that the information presented is available in a manner such as to be compatible with the method of determination of wind loads as defined in the United Kingdom BSI code of practice, CP3, ch. 5, Pt. 2 (1972). It is fortunate, in this respect, that most of the data is available from US sources which have a similar codified method of application. Concern for data on wind loads on solar collectors arises from the fact that they present unique, and currently uncodified, geometrical arrangements to the oncoming wind flow for all but flush mounted panels.

6643 **(PB—84-233980) Evaluation of wind speeds over roof mounted solar collectors.** Evans, R.A.; Lee, B.E. (Sheffield Univ. (UK). Dept. of Building Science). Apr 1983. 103p. (BS—73). NTIS, PC E06/MF E06.

One of the factors which influences the performance of a solar energy system is the reduction in its efficiency caused by forced convective heat transfer due to wind action. This is particularly important in the case of unglazed collectors and may also be significant for glazed collectors under certain circumstances. Various correlations have been proposed relating the convective heat loss coefficient, h, to the air velocity across the collector cover plate, v. These vary from linear to square root dependence of h on v and most are based on measurements at relatively low wind velocities. Thus the solar energy system designer is in a position to evaluate the wind induced forced convective heat loss from a collector once a design value of the surface wind speed v has been derived.

6644 **(PB—84-234905) Experimental demonstration of a high performance flat plate collector field with isothermal heat transport and heat storage in a stratified water tank.** Merges, V.; Klippel, E. (Commission of the European Communities, Luxembourg). 1983. 49p. (In German and English). (EUR—8798-DE-EN). NTIS, PC E03/MF E03.

In ordinary solar flat plate collector plants a liquid heat transport medium is circulated with a pump according to the insolation. Thereby the need of electricity, the morning preheating bypass and the elevated collector temperature are disadvantageous. Beside the first demonstration of MBB high performance flat plate collectors the objective of the described program is to prove that these disadvantageous can be avoided. Circulating water is driven by gravity in form of steam at the hot side and in the liquid phase at the cold side. Temperature is determined by the pressure of the gas buffer. Preheating occurs by natural liquid convection, at higher insolations boiling starts automatically. Elevated collector temperature is eliminated by the high heat transfer due to phase change, by compensation of pipe heat losses without temperature drop (isothermal condensation) and by a uniform temperature all over the collector field.

6645 **(SERI/PR—255-1894) Advanced glazings research. Progress report, October 1981-March 1983.** Benson, D.K.; Tracy, C.E.; Coyle, T.R.; Masterson, K. (Solar Energy Research Inst., Golden, CO (USA)). Nov 1984. Contract AC02-83CH10093. 66p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85000539.

The objective of this research task was to explore the feasibility of improving the insulating value of cover plates and thereby produce a flat-plate collector that could be operated efficiently at high temperatures. An evacuated, sealed glass cover plate with integral infrared reflective coating was designed and analyzed. Experiments suggest that a laser welding technique could be used to fabricate such a glazing economically.

6646 **(SERI/TP—252-2295) Heat and mass exchange in a partially stratified fluid.** Zangrando, F.; Green, J.; Fisher, E. (Solar Energy Research Inst., Golden, CO (USA)). Sep 1984. Contract AC02-83CH10093. 7p. (CONF-840816—24). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85000528.

From 22. national heat transfer conference; Niagara Falls, NY, USA (5 Aug 1984).

Laboratory experiments were conducted to investigate the process of heat and mass exchange in a partially stratified fluid containing gradients of temperature and salinity. The test cell of dimensions 2 m deep x 1 m wide x 5 m long is insulated and bottom

heated. The stably stratified region (gradient) was established over approximately one half the depth of the test tank, while the remaining depth was initially at a constant, high density (storage or mixed region). Fluid from the mixed region was withdrawn, circulated through an external heat exchanger, and returned at a lower temperature. Tests were primarily aimed at identifying the effects of the recirculating flow on the interface between gradient and storage regions, and determining the maximum rate at which energy can be extracted from such systems, with direct application to energy extraction from salt gradient solar ponds. Results obtained are presented over a broad range of conditions. In addition to the expected dependence on Richardson number, they also indicate a dependence on the stability number near the interface, although this dependence needs to be quantified in further tests. Critical conditions and parameter ranges in which no net erosion of the interface was observed are also discussed.

6647 **Modeling of the surface convective layer of salt-gradient solar ponds.** Cha, Y.S.; Sha, W.T. (Argonne National Laboratory, Argonne, IL). *Journal of Solar Energy Engineering;* **104**: No. 4, 293-298(Nov 1982).

A one-dimensional numerical model is developed to predict the diurnal variations of vertical temperature and concentration profiles in salt-gradient solar ponds. The model employs augmented thermal and mass diffusivities due to turbulent wind mixing and double-diffusive convection. Numerical results indicate that the thickness of the surface convective layer increases with wind speed (or the wavelength of the surface wave). Double-diffusive convection is, in the absence of wind, capable of sustaining a mixed layer at the surface when strong cooling occurs over the pond. In field ponds, the surface convective layer is probably maintained as a result of the combined action of wind-generated turbulent mixing and doublediffusive convection.

6648 **An experimental investigation of a stationary reflector/tracking absorber solar collector at intermediate temperature.** Fuiter, E.; Grossman, G. (Faculty of Mechanical Engineering, Technion-Israel Institute of Technology, Haifa). *Journal of Solar Energy Engineering;* **104**: No. 4, 340-344(Nov 1982).

This paper describes the design, construction, and testing of a concentrating solar collector based on the Stationary Reflector/Tracking Absorber (SRTA) principle. The system consists of a fixed, 2.5-m dia, spherical mirror which focuses solar radiation on a movable, cylindrical absorber tracking the sun. This work is an extension of earlier tests with a similar collector in which output temperatures up to 150°C were obtained with water. The present system, using a mineral-oil-based heat transfer fluid, was capable of heating the fluid up to 300°C under steady-state conditions. The direct radiation efficiency ranged from 50 percent at low temperatures up to 30 percent near 300°C, showing the SRTA to be an effective concentrating collector for the intermediate temperature range which can be constructed at relatively low cost.

6649 **Systematic rotation and receiver location error effects on parobolic trough annual performance.** Treadwell, G.W.; Grandjean, N.R. (Sandia National Laboratories, Albuquerque, NM). *Journal of Solar Energy Engineering;* **104**: No. 4, 345-348(Nov 1982).

This report deals with the effects of certain systematic errors on performance and, therefore, their influence on the design of troughs. Systematic rotation error is the angle between the reflector vertex-focus axis and the vertex-sun axis; systematic receiver location error is the vectorial deviation of a receiver from focus. The existence of systematic rotation errors and systematic receiver location errors can have a significant effect on the annual performance of parabolic trough collectors. These systematic errors can exist in addition to errors which are random in nature and which, therefore, can be treated statistically. Systematic rotation errors of 16 milliradians result in annual performance degradation of greater than 30 percent. Systematic receiver location errors can have a similar effect depending upon magnitude. The technique for calculating the influence of systematic errors on performance is outlined and methods of identifying and minimizing these errors are suggested.

6650 **Incident angle modifiers for flat-plate solar collectors: analysis of measurement and calculation procedures.** Thomas, W.C.; Dawson, A.G. III. (Mechanical Engineering Department, Virginia Polytechnic Institute, VA). *Journal of Solar Energy Engineering;* **104**: No. 4, 349-357(Nov 1982).

Existing test procedures for measuring and rating thermal performance require the determination of the angular response of collectors in order to account for nonnormal incident beam irradiance. Angular response measurements for four different types of collectors, each type tested by three different laboratories, are presented and analyzed. Substantial differences, both within and between laboratories, are reported for the same type collectors. An analysis of the measurement procedure shows that experimentally determined angular response parameters are subject to relatively large uncertainties. The problem results to a large extent from measuring collector efficiencies at non-normal incident angles where measurement uncertainty is of the same order of magnitude as the efficiency reduction attributable to these off-normal angles. Other factors which can affect angular response measurements and the method of correlating results are also discussed. A theoretical analysis shows that shading of the absorber by the collector air space side- and end-walls for non-normal incident angles can be of the same order of importance as the decrease in the transmittance of the cover assembly. While this situation complicates an analytical approach, it is concluded that calculations are adequate to depict the angular response of conventional flat-plate tube-in-sheet collector designs. A simplified analytical procedure and nomographs are presented for rapid calculation of incident angle modifiers. The predicted seasonal performance of solar energy systems and clear-day ratings of typical flatplate collectors are shown to be relatively insensitive to large uncertainties in incident angle modifiers. Typically, the values of these calculated quantities could be affected by approximately five percent as a result of uncertainty in the test-derived angular response parameter.

6651 **Recent progress in terrestrial photovoltaic collector technology.** Ferber, R.R. (California Inst. of Tech., Pasadena). pp 364-368 of Photovoltaic solar energy conference. Dordrecht, Netherlands; D. Reidel Publishing Company (1982). (CONF-820555—).

From 4. photovoltaic solar energy conference; Stresa, Italy (10 May 1982).

The U.S. Photovoltaic Research and Development Program has the objective to develop the technology necessary to foster widespread grid-competitive electric power generation by the late 1980s. The flat-plate and the concentrator collector activities form the nucleus of the program. The project is concerned with the refining of silicon, silicon sheet production, solar cell processing and fabrication, encapsulation materials development, and collector design and production. The Large-Area Silicon Sheet Task has the objective to develop and demonstrate the feasibility of several methods for producing large area silicon sheet material suitable for fabricating low-cost, high-efficiency solar cells. It is expected that a variety of economic flat-plate and concentrator collectors will become commercially available for grid-connected applications.

6652 **Photovoltaic concentrator technology in the USA.** Boes, E.C.; Edenburn, M.W. (Sandia National Lab., Albuquerque, NM). pp 600-605 of Photovoltaic solar energy conference. Dordrecht, Netherlands; D. Reidel Publishing Company (1982). (CONF-820555—).

From 4. photovoltaic solar energy conference; Stresa, Italy (10 May 1982).

Research on the design of solar concentrators since about 1979 is surveyed. Concentrator modules employing point-focus-Fresnel, linear-Fresnel, parabolic-trough, and advanced point-focus-Fresnel optical elements are characterized. The Fresnel types are found to be more effective than the parabolic troughs. Tracking-structure types and array experiments are listed. Cell-efficiency improvements (such as planar-junction silicon cells, GaAlAs cells, and spectrum-splitting combinations) are seen as critical for enhancing module performance. Materials for use in heat exchangers and optics are discussed. Present microprocessor control of array pointing using closed-loop/sun-sensor or open-loop/ephemeris tracking is considered adequate. Information on durability testing, a table of estimated array costs, and a table of design characterstics and effi-

ciencies for operational and experimental concentrators are presented. Concentrators delivering up to 20-percent efficiency over a 20-year lifetime at an installed cost of $1-$2/peak W are considered feasible. 14 references.

6653 **Solar selective properties and high temperature stability of CVD $ZrB_2$.** Randich, E.; Pettit, R.B. (Sandia National Labs., Albuquerque, NM). *Solar Energy Materials;* **5**: 425-435(1981). Contract AC04-76DP00789.

Coatings of $ZrB_2$ for photothermal solar absorber applications have been prepared by chemical vapor deposition (CVD). Solar absorptance and emittance (100°C) are reported for CVD $ZrB_2$ and hot pressed $ZrB_2$. Antireflection coatings of $Si_3N_4$ increase the solar absorptance of CVD $ZrB_2$ from initial values of 0.46-0.77 to 0.88-0.93 while only increasing the emittance (100°C) from 0.08 to 0.10. High temperature aging experiments at 400 and 500°C in air show the $Si_3N_4/ZrB_2$ coatings to be stable for at least 1000 h. Aging experiments at 600°C in air show a slight degradation in optical properties after 300 h. The change at 600°C in air show a slight degradation in optical properties after 300 h. The change at 600°C appears to result from oxidation of the $Si_3N_4$ antireflection layer.

6654 **Wavelength dependent scattering caused by dust accumulation on solar mirrors.** Pettit, R.B.; Freese, J.M. (Sandia Labs., Albuquerque, NM). *Solar Energy Materials;* **3**: 1-20(1980). Contract AC04-76DP00789.

The reflectance properties of several solar mirror materials have been studied after the mirrors were subjected to ten months of outdoor exposure in Albuquerque, NM. The mirror materials include second-surface, silvered float glass; an aluminized acrylic film; an aluminized teflon film; and a roll polished aluminum sheet. The specular reflectance properties were measured as a function of angular aperture using a bidirectional reflectometer while the diffuse reflectance and hemispherical reflectance were measured using an integrating sphere reflectometer. The outdoor exposure resulted in a buildup on the mirror surface of particulates, which can both scatter and absorb incident solar radiation. For the materials studied, the reduction in specular reflectance was approximately five times greater than the reduction in hemispherical reflectance, indicating that the deposited particles are much more effective in scattering radiation than absorbing it. The specular reflectance loss caused by the accumulated dust particles was measured for each mirror during the 10 month exposure. When normalized by the hemispherical reflectance of each mirror, the wavelength dependence of the normalized scattering curves were identical for all mirrors after the same exposure time. The normalized scattering curve changes during the course of the outdoor exposure, suggesting that the particle size distribution of accumulated dust is changing with time. Over the 10 month period, the average decrease in the specular reflectance measured at 500 nm was slightly smaller for the silvered glass mirror as compared to the aluminized acrylic and aluminized teflon mirrors. The measurement statistics associated with determining the mean reflectance value after outdoor exposure from a number of discrete measurements are briefly discussed.

## 1420 Heat Storage

*REFER ALSO TO CITATION(S) 1420006602, 6621, 6622*

6655 **(NBSIR—84-2942) Evaluation of ettringite and related compounds for use in solar energy storage. Progress report.** Struble, L.J.; Brown, P.W. (National Engineering Lab. (NBS), Washington, DC (USA)). Oct 1984. Contract AI01-76PR06010. 44p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85003249.

This report describes an investigation of ettringite and related phases for potential application in solar energy storage. The specific objective is to evaluate the potential of ettringite dehydration and rehydration as a phase change process for energy storage. Synthesis procedures have been developed, and a number of ettringite-type phases have been prepared. The heat capacity of each phase was approximately 0.3 calories per gram per degree Celsius. Studies of the dehydration of these phases at atmospheric pressure indicate that the material has good potential as a phase change material for solar energy storage. Dehydration occurred at temperatures in the range between approximately 30°C and 55°C, with changes in enthalpy ranging between 100 and 240 calories per gram of sample. In addition, ettringite was found to have a reversible hydrothermal reaction at approximately 50°C, with an enthalpy change of approximately 4 calories per gram sample.

6656 **(NP—5900101) Central solar heating plants with seasonal storage: heat storage models - evaluation and selection.** Hadorn, J.C.; Chuard, P. (Sorane SA, Lausanne (Switzerland)). Jun 1983. 185p. NTIS (US Sales Only), PC A09/MF A01. File Number DE85900101.

This report deals with the simulation models for seasonal sensible heat storage. The aim is to evaluate and select computer programs which would be suitable for the needs of the IEA Task VII, dealing with Central Solar Heating Plants with Seasonal Storage (CSHPSS). The report gathers information about existing heat storage models among the ten participating countries, describes in detail some available models for different families of seasonal storage, and presents the evaluation and the final selection of models to be considered as common tools in the optimization and design of CSHPSS.

6657 **Flow and heat transfer of a stably stratified fluid through an enclosure.** Chaney, S.R.; Humphrey, J.A.C.; Month, L.; Shah, A. (Department of Mechanical Engineering, University of California, Berkeley, CA). *Journal of Solar Energy Engineering;* **106**: No. 3, 261-270(Aug 1984).

The flow of a stably stratified fluid, or thermocline, through a cubical enclosure with: (a) strongly conducting; and (b) weakly conducting side-walls, was investigated experimentally. The flow Peclet number and enclosure aspect ratio were varied in the experiment. Flow visualization revealed buoyancy-affected motions in both side-wall configurations. During the charging period of an energy storage cycle, for the strongly conducting side-wall case, axial heat conduction along the side-wall induced an upward-directed buoyant force on the fluid adjacent to the wall in the lower (colder) part of the enclosure. This was in contrast to a downward-directed force on near-wall fluid in the weakly conducting side-wall case. However, the motions induced by the forces were relatively weak compared to the main flow, and in the weakly conducting wall case appeared to be confined to thin fluid layers adjacent to the enclosure side-walls. The cumulative influence of buoyant forces was most noticeable for long times, in flows with small Peclet number and conducting side-walls. Measurements of temperature and of the energy storage performance characteristics of the thermocline were made as a function of time. Predictions of these quantities based on the analytical solution of the transient, one-dimensional, energy conservation equation are in good agreement with the measurements.

6658 **The use of ground-coupled tanks in solar-assisted heat-pump systems.** Metz, P.D. (Solar and Renewable Energy Division, Brookhaven National Laboratory, Upton, NY). *Journal of Solar Energy Engineering;* **104**: No. 4, 366-372(Nov 1982).

A research program at Brookhaven National Laboratory (BNL) has studied ground coupling, i.e., the use of the earth as a heat source/sink or storage element, for solar-assisted heat-pump systems. As part of this research program, four buried tank experiments were operated between December 1978 and March 1981 in order to determine the feasibility of ground-coupled tanks in these systems. Heat was added to or removed from the tanks according to a weekly schedule derived from computer simulations of solar heat-pump systems in the local (New York) climate. Each tank was operated according to a different control strategy. This paper presents experimental results from these tank experiments for this period, and compares these results to those generated by a computer model, GROCS, developed at BNL. The model is found to be valid, for the most part, using undisturbed soil thermal properties which provide the best fit to the data most of the time. Its results are very sensitive to soil thermal conductivity during periods of large heat addition to the tanks. A ground coupled tank is found to be desirable in series solar-assisted heat-pump systems. However, no

important carry-over of summer-collected heat to winter was observed.

# 15 GEOTHERMAL ENERGY

## 1501 Resource Status And Assessment

*REFER ALSO TO CITATION(S) 1501006711*

6659 (EPRI-AP—3686, pp 6.1-6.15) **Worldwide geothermal power development: 1984 overview and update.** DiPippo, R. (Southeastern Massachusetts Univ., North Dartmouth). Aug 1984. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920020. (CONF-8406201—).

From 8. annual geothermal conference and workshop; Seattle, WA, USA (25 Jun 1984).

The status of geothermal power plants as of mid-1984 is given. There are 15 countries with active plants, and France (Guadeloupe) is expected to join the roster in the near future. The total number of operating units (defined as an individual turbogenerator set) is 146; the total installed capacity is almost 3825 MW. If plans for additional plants are met, the total could jump by more than 2000 MW over the next two years. Recent growth is presented which traces the worldwide installed capacity as reported in earlier surveys. A graphic portrayal of the growth pattern is given.

6660 (EPRI-AP—3686, pp 5.19-5.22) **Geopressure-geothermal: an update.** Swanson, R.K.; Bernard, W.J. (Southwest Research Inst., San Antonio, TX). Aug 1984. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920020. (CONF-8406201—).

From 8. annual geothermal conference and workshop; Seattle, WA, USA (25 Jun 1984).

The largest known geothermal prospect in the southern part of the US is contained in deep sediments along the Texas and Louisiana Gulf Coast, known collectively as geopressured zones. They occur at depths below 10,000 feet or so, and cover an area which may be as large as 100,000 square miles. These zones consist of sandstones and shales saturated with natural brine of varying salinity, and may attain pressures approaching lithostatic. The water is apparently saturated with dissolved natural gas, primarily methane. At 15,000 feet or so, temperatures attain values of 140° to 150°C. Because of the extremely high pressure, wells drilled into sandstones with adequate reservoir properties, are capable of flowing at high rates without pumping. The modest thermal energy contained in the water and the dissolved methane, which is freely separated at the surface, comprise the principal energy value of the resource. A relatively small amount of hydraulic energy may also be recoverable. The potential of this large and highly publicized resource is assessed with a view toward placing it in proper perspective.

6661 (EPRI-AP—3686, pp 4.1-4.3) **EPRI geothermal power systems research program.** Roberts, V.W. (Electric Power Research Inst., Palo Alto, CA). Aug 1984. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920020. (CONF-8406201—).

From 8. annual geothermal conference and workshop; Seattle, WA, USA (25 Jun 1984).

The overall direction of the geothermal R and D program at EPRI is reviewed and some of the logic that has steered the program to its present course is summarized. EPRI's charter is to address the technical issues faced by electric industry and the geothermal program has been no exception. It is not surprising then that the institutional issues that the geothermal industry has had to wrestle with over the past several years are not addressed. However, the technical side of environmental issues do fall within the charter. The geothermal program started at EPRI in 1974. By mid-1975, the philosophical basis for the work that would follow had already been formulated. A goal was selected to be broad enough to allow the program to apply its efforts over a wide range of technical disciplines. The goal was, and still is, simply to concentrate EPRI's resources on those technical issues that will help to accelerate the development of geothermal energy.

6662 (EPRI-AP—3686, pp 1.3-1.5) **Resource planning, screening and acquisition: a public utility perspective.** Macdonald, M.; Docter, D. (Seattle City Light, WA). Aug 1984. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920020. (CONF-8406201—).

From 8. annual geothermal conference and workshop; Seattle, WA, USA (25 Jun 1984).

A discussion is presented on how a resource such as geothermal energy might move from the academic or research realm to become a part of a large utility's resource. Seattle City Light's resource planning is discussed under the following topics: planning perspective, research and development, and the planning process.

6663 (EPRI-AP—3686, pp 3.11-3.13) **Hawaiian Electric Company's geothermal activities.** Uemura, R.T. (Hawaiian Electric Company, Inc., Honolulu). Aug 1984. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920020. (CONF-8406201—).

From 8. annual geothermal conference and workshop; Seattle, WA, USA (25 Jun 1984).

The development of geothermal energy in Hawaii is discussed. The development of this energy resource is important because the island is isolated from conventional, fossil fuel supplies by thousands of miles of ocean. The commercial development of geothermal resources on the Islands of Hawaii, Maui, Oahu is discussed.

6664 (EPRI-AP—3686, pp 3.14-3.16) **Geothermal activities - 1984: Los Angeles Department of Water and Power.** Sugine, S.S.; Briffett, R.A. (Los Angeles Dept. of Water and Power, CA). Aug 1984. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920020. (CONF-8406201—).

From 8. annual geothermal conference and workshop; Seattle, WA, USA (25 Jun 1984).

The Los Angeles Department of Water and Power's geothermal activities center around the Coso Geothermal Project and the North Brawley Geothermal Project. The Department also owns land in the Mono-Long Valley Known Geothermal Resource Area that may have geothermal potential. The Coso and the North Brawley Geothermal Projects are discussed. The Department has no immediate plans for developing the Mono-Long Valley lands, but the use of third parties to explore and develop the lands is being considered.

6665 (EPRI-AP—3686, pp 3.33-3.36) **Seattle City Light: geothermal exploration studies.** Spinney, P.J.; Groner, G.P.; Best, L. (Seattle City Light, WA). Aug 1984. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920020. (CONF-8406201—).

From 8. annual geothermal conference and workshop; Seattle, WA, USA (25 Jun 1984).

Seattle City Light (SCL) is the nation's fifth largest municipally-owned electric utility, serving a population of over 600,000 and generating approximately 65% of its own power. The utility began its own Research and Development (R and D) program in 1972. This program has grown considerably since its inception, and includes projects in the areas of conservation, alternative generation and system-related research. As part of its alternative generation efforts, SCL has been looking into the potential of geothermal energy since 1978. In 1981, the utility began its geothermal exploration studies at Mt. Baker, a large volcano located approximately 100 miles northeast of Seattle. The geothermal exploration project at Mt. Baker is described in terms of its history, its most salient features, and its prospects for the future. SCL's approach to the environmental implications of geothermal activity at Mt. Baker are emphasized. SCL's comprehensive, proactive approach appears to offer real advantages toward the development of geothermal energy resources in a cost-effective, environmentally responsible manner.

6666 (EPRI-AP—3686, pp 3.37-3.38) **Meager Creek Geothermal Project: testing and monitoring during 1983 - 1984.** Stauder, J.J.; Croft, S.A.S. (British Columbia Hydro, Vancouver). Aug 1984. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920020. (CONF-8406201—).

From 8. annual geothermal conference and workshop; Seattle, WA, USA (25 Jun 1984).

The poor economic climate and diminished load forecasts severely curtailed exploration at British Columbia Hydro's Meager Creek Geothermal Project during 1983/84. Under the budgetary constraints imposed by the maintenance program, site activity was reduced to testing and monitoring of the producing well, MC-1, and the two static wells, MC-2 and MC-3. The testing program on MC-1 included the installation of a single flash 20kW test turbine generator unit.

6667 (EPRI-AP—3686, pp 3.42-3.46) **Cost and performance analysis of wellhead and central geothermal power plant development at Roosevelt Hot Springs.** Eldredge, D.L.; Rasband, J.L. (Utah Power and Light Co., Salt Lake City). Aug 1984. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920020. (CONF-8406201—).

From 8. annual geothermal conference and workshop; Seattle, WA, USA (25 Jun 1984).

Utah Power and Light Company (UP and L) has been studying the development of economic alternative power sources to large coal-fired power plants. This effort includes the new 20 MW Milford No. 1 Geothermal Power Plant and future development of the Roosevelt Hot Springs geothermal resource near Milford, Utah. To facilitate further development of Roosevelt Hot Springs, a study was undertaken to evaluate the economics of central plant and wellhead plant development schemes at the resource, compared to UPandL's present coal-fired plants. Major goals of the study were to assess available technology and its application at Roosevelt, as well as appropriate development schemes for comparison. For study purposes, it was decided to compare 100 MW of geothermal capacity from each of the technologies looked at. It was felt that 100 MW of capacity would give a fair representation of the operating costs of each technology at a mature resource. Once technologies were agreed upon, each was assessed for capital cost, operating cost and fuel cost. While these costs would naturally reflect their application at the Roosevelt resource (particularly the fuel costs), some areas of sensitivity were applicable to a wide range of geothermal resources. Three basic technologies were chosen to investigate: conventional 50 MW central plant, the RST wellhead plant, and two binary wellhead plants.

6668 (NP—5900393) **Renewable energy: energy from geothermal resources.** (Florida State Energy Office, Tallahassee (USA)). Nov 1984. 18p. Governors Energy Office, The Capital, Tallahassee, FL 32301. File Number TI85900393.

Geothermal resources, as traditionally defined, are not likely to make a major contribution to Florida's energy supply. Areas of interest include utilization of above average thermal gradients found in the Florida Panhandle and groundwater heat pump applications. Federal investment tax incentives limit the development of applications for Florida's low-grade geothermal gradients. Regulations require that extracted geothermal water must be 122°F or hotter. Most sub-surface waters in Florida that can be economically used for heating or cooling purposes fall below this temperature. Groundwater heat pumps are widely used today in Florida and could increase in importance in coming years. This kind of heat pump takes advantage of groundwater being cooler than ambient air temperatures in the summer and warmer in the winter. The closed loop system probably has better potential for Florida than other systems because it requires less energy to operate pumps and poses no threat to Florida's groundwater resources.

6669 (SAND—83-1361) **Shallow magma targets in the western US.** Hardee, H.C. (Sandia National Labs., Albuquerque, NM (USA)). Oct 1984. Contract AC04-76DP00789. 39p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85003274.

Within the next few years a hole will be drilled into a shallow magma body in the western US for the purpose of evaluating the engineering feasibility of magma energy. This paper examines potential drilling sites for these engineering feasibility experiments. Target sites high on the list are ones that currently exhibit good geophysical and geological data for shallow magma and also have reasonable operational requirements. Top ranked sites for the first magma energy well are Long Valley, CA, and Coso/Indian Wells, CA. Kilauea, HI, also in the top group, is an attractive site for some limited field experiments. A number of additional sites offer promise as eventual magma energy sites, but sparsity of geophysical data presently prevents these sites from being considered for the first magma energy well.

6670 **Introduction to geothermal energy.** Stephens, R. (Dept. of Energy, Washington, DC). pp 29-36 of Use of geothermal energy for electric power generation by rural electric cooperatives in the western United States. Mashaw, J.M.; Prichett, W. III (eds.). San Diego, CA, USA; National Rural Electric Cooperative Association (1980). (CONF-8010341—).

From Use of geothermal energy for electric power generation workshop; San Diego, CA, USA (21 Oct 1980).

The major types of geothermal energy than can be considered for use in the next couple of decades are reviewed and the major locations and development stages of these resources are described. Some current-technology small-scale applications of geothermal energy of interest to rural co-ops are discussed briefly.

6671 **Geothermal energy and the national energy picture.** Black, R.A. (Dept. of Energy, Washington, DC). pp 6-16 of Use of geothermal energy for electric power generation by rural electric cooperatives in the western United States. Mashaw, J.M.; Prichett, W. III (eds.). San Diego, CA, USA; National Rural Electric Cooperative Association (1980). (CONF-8010341—).

From Use of geothermal energy for electric power generation workshop; San Diego, CA, USA (21 Oct 1980).

The national energy picture is reviewed and several major actions necessary for achieving energy security are discussed. The development of alternative energy sources with emphasis on geothermal resources is discussed. The current status of the national geothermal program is highlighted.

## 1502 Geology And Hydrology Of Geothermal Systems

*REFER ALSO TO CITATION(S) 1502006682, 6689*

6672 **Geothermal resources in the United States.** Foley, D. (Univ. of Utah, Salt Lake City). pp 48-54 of Use of geothermal energy for electric power generation by rural electric cooperatives in the western United States. Mashaw, J.M.; Prichett, W. III (eds.). San Diego, CA, USA; National Rural Electric Cooperative Association (1980). (CONF-8010341—).

From Use of geothermal energy for electric power generation workshop; San Diego, CA, USA (21 Oct 1980).

The geological and geophysical characteristics of geothermal resource areas in the United States are reviewed. Requirements for successful exploitation of these resources are also discussed.

## 1503 Geothermal Exploration And Exploration Technology

*REFER ALSO TO CITATION(S) 1503006660, 6672*

6673 (DOE/SF/11720—T2) **Reconnaissance of geothermal resources near US naval facilities in the San Diego area, California.** Youngs, L.G. (California State Dept. of Conservation, Sacramento (USA). Div. of Mines and Geology ). 1984. Contract AC03-83SF11720. 73p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85002993.

A reconnaissance study has found little evidence of potential geothermal resources useful at naval facilities in the greater San Diego metropolitan area. However, there is a zone of modest elevated water well temperatures and slightly elevated thermal gradi-

ents that may include the eastern portion of the Imperial Beach Naval Air Station south of San Diego Bay. An increase of 0.3° to 0.4°F/100 ft over the regional thermal gradient of 1.56°F/100 ft was conservatively calculated for this zone. The thermal gradient can be used to predict 150°F temperatures at a depth of approximately 4000 ft. This zone of greatest potential for a viable geothermal resource lies within a negative gravity anomaly thought to be caused by a tensionally developed graben, approximately centered over the San Diego Bay. Water well production in this zone is good to high, with 300 gpm often quoted as common for wells in this area. The concentration of total dissolved solids (TDS) in the deeper wells in this zone is relatively high due to intrusion of sea water. Productive geothermal wells may have to be drilled to depths economically infeasible for development of the resource in the area of discussion.

6674 **(DOE/SF/11720—T3) Geothermal energy at Long Beach Naval Shipyard and Naval Station and at Seal Beach Naval Weapons Station, California. Final Report 1.** Higgins, C.T.; Chapman, R.H. (California State Dept. of Conservation, Sacramento (USA). Div. of Mines and Geology ). 1984. Contract AC03-83SF11720. 110p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE85002994.

The purpose of this project was to determine and evaluate sources of geothermal energy at two military bases in southern California, the Long Beach Naval Shipyard and Naval Station and the Seal Beach Naval Weapons Station. One part of the project focused on the natural geothermal characteristics beneath the naval bases. Another part focused on the geothermal energy produced by oilfield operations on and adjacent to each base. Results of the study are presented here for the US Department of the Navy to use in its program to reduce its reliance on petroleum by the development of different sources of energy. The project required research of various reports and data, both published and unpublished, particularly those of the California Department of Conservation, Division of Oil and Gas and of oil companies with leases on or adjacent to the naval bases. Important field investigations included the measurement of well-head temperatures of fluids produced from selected oil wells at each naval base and a detailed gravity survey of the Seal Beach naval base and vicinity. The well-head temperatures were needed to evaluate individual wells as sources of geothermal energy, while the gravity survey attempted to discover subsurface geologic structures that might contain geothermal fluids of temperatures higher than those predicted by the regional geothermal conditions.

6675 (EPRI-AP—3686, pp 4.4-4.8) **IIE geothermal R and D program: 1984 update.** Mulas, P.; Hernandez, J.L.G.; Nieva, D. (Instituto de Investigaciones Electricas, Cuernavaca, Mexico). Aug 1984. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920020. (CONF-8406201—).

From 8. annual geothermal conference and workshop; Seattle, WA, USA (25 Jun 1984).

In the last two years, the geothermal research program of the Instituto de Investigaciones Electricas has consolidated itself in those areas of endeavor that were decided upon a few years ago. Basically, those activities have led to results which have been applied to solve specific problems, and to new projects which are consolidating the research groups that were then created. At present, the 400 MWe plant operating in Cerro Prieto I (180 MWe) and Cerro Prieto II (220 MWe) and the five 5 MWe wellhead units at Los Azufres, the well drilling activities in the fields of San Marcos and La Primavera in the State of Jalisco, near the city of Guadalajara, and in Los Humeros, in the State of Puebla, near the city of Jalapa, the construction of Cerro Prieto III (220 MWe), and the recent approval of the installation of 55 MWe unit for Los Azufres as well as ten more 5 MWe wellhead units in this field and in Los Humeros, generate a wide assortment of interesting research projects for the geothermal program as well as for other research institutes in Mexico. The activities are carried out in three main generic areas: exploration, field development, and field and plant operation. These activities are discussed.

6676 **(EUR—8715) Data sheets and state of progress of the geothermal demonstration projects.** (Commission of the European Communities, Luxembourg). 1983. 69p. (EUR—8715-EN). NTIS, PC E04/MF E04.

The 56 projects which cover the years 1978 to 1982 have investigated geothermal reservoirs within the EEC. Reports in condensed form are presented giving localities, objectives, and state of progress of each project.

6677 **(EUR—8717) Community demonstration project: geothermal exploration drilling at Lamazere. Final drilling report.** de Barbentane, P. (Commission of the European Communities, Luxembourg). 1983. 68p. (In French). (EUR—8717-FR). NTIS, PC E04/MF E04.

A borehole 1,750 m deep was sunk in 1981 at Lamazere, Aquitaine, France, in order to evaluate the possible use of the geothermal fluids trapped in sub-surface rocks. The geological formations are described together with tests, analyses, drilling data, and the results of a production test at the close of the operation. The reservoir contains water with a low mineral content at a temperature of 58.8 degrees C. No conclusion as to possible exploitation of the reservoir is given in the report.

6678 **(EUR—8718) Community demonstration project: geothermal exploration drilling at Provins. Final drilling report.** de Barbentane, P. (Commission of the European Communities, Luxembourg). 1983. 74p. (In French). (EUR—8718-FR). NTIS, PC E04/MF E04.

1,612m in the Lusitanian formation in the Paris basin near Provins in order to investigate the geothermal reservoir in the limestone and to evaluate the possible exploitation of the reservoir. A description of the rocks encountered during drilling is given together with the analyses, logs, and drilling data. The temperature of the trapped water is 63-65 degrees C; the permeability of the rocks is rather low. No conclusion as to possible usage of the water is indicated in the report.

6679 **(EUR—8720) Community demonstration project: geothermal drilling at Bordeaux Meriadeck. Final drilling report.** (Commission of the European Communities, Luxembourg). 1983. 43p. (In French). (EUR—8720-FR). NTIS, PC E03/MF E03.

In order to exploit the underground Cenomano-Turonien water-table within the Bordeaux area, geothermal drilling was started in 1980 to take advantage of the drinking water and industrial water resources. The drilling work, the technical characteristics, the geology of the strata, the geochemistry of the water, the test pumping operations, and the potential production of the well are described. The project was completed in 1981 and the depth reached was 1,148.80 m below ground level. The water table was located at a depth between 930.20 m to 1,127 m. The temperature of the water was around 50 degrees C.

6680 **(EUR—8721) Community demonstration project: Geothermal drilling at Hoogstraten. Final drilling report.** (Commission of the European Communities, Luxembourg). 1983. 55p. (In French). (EUR—8721-FR). NTIS, PC E04/MF E04.

The Meer-Hoogstraten project aimed to exploit a geothermal reservoir of Viseen limestone by drilling twin wells to a depth of 1,800m. The volume of the reservoir and the composition and temperature of the waters were estimated in order to evaluate the potential of the reservoir. Drilling operations are detailed but conditions met with in the hole made it impossible to achieve the aim of the project. The well is now considered only as an exploration project.

6681 **(EUR—8722) Community demonstration project: Geothermal wells at Cesano. Final drilling report.** (Commission of the European Communities, Luxembourg). 1983. 97p. (In English and Italian). (EUR—8722-EN/IT). NTIS, PC E05/MF E05.

Exploration drilling of the Cesano concession located two wells of interest: Cesano 7 and 8. Cesano 7 well has confirmed that the central-northern part of the concession contains a permeable

reservoir of geothermal interest within the Liassic limestones. The fluid in this reservoir consists of a brine at more than 220 degrees C and small quantities of gas. Preliminary data suggest a total salinity of about 70,000 ppm, with a prevalence of chlorides and sulphates; the flow-rate exceeded 300 cu m/h, with a well-head temperature and pressure of 180 degrees C and 25 kg/sq cm respectively. Surface equipment is being constructed for long-term production tests. Exploration drilling of the Cesano 8 well is being undertaken: (a) to verify the existence of circulating geothermal fluids in correspondence with the vulcanic distrema, (b) to check the lithostratigraphic sequence, (c) to calibrate geophysical parameters, (d) to measure temperature and conductivity in order to calculate the gradient and the thermal flow, (e) to study the permeability of formation and localization of water tables, and (f) to test the productive capacity of the potential reservoir and to study geochemical and thermodynamic details of the fluids. The data available about the fluids suggest that the brines come from independent pockets of small dimensions.

6682 **(EUR—8724) Community demonstration project: geothermal well at Southampton. Final drilling report.** (Commission of the European Communities, Luxembourg). 1983. 65p. (EUR—8724-EN). NTIS, PC E04/MF E04.

Hot brines from Triassic sandstones of a thickness estimated at 11 meters and found at depths of 1,729 to 1,796 meters have been investigated. Physical properties of the major formations include gamma-ray activity, sonic velocities, resistivities, and at the well bottom, raised temperatures. The drilling cores were used to obtain hydraulic conductivities, porosities and densities from which transmissivity has been estimated (4.5 Dm). Engineering details of the drilling operations, stratigraphy, lithography, chemical analyses of formation fluids, and hydrogeology of the sandstones are included. Production capacity was assessed by gas lifting (yield 30 liters/s). Comparisons with an earlier well 1.9 km distant imply the presence of a hydraulic boundary nearby.

6683 **(EUR—8726) Community demonstration project: geothermal borehole at Ghlin Mons. Final drilling report.** (Commission of the European Communities, Luxembourg). 1983. 62p. (In French). (EUR—8726-FR). NTIS, PC E04/MF E04.

The St-Ghislain and Douvrain drilling operations have revealed the hydrodynamic and geochemical features of the geothermal water table which pervades the deep carboniferous limestone of the region. The two operations lie to the south of the sloping Baudour levels. The question is whether the hydrological situation, which for that zone is now better understood, continues towards the east, up to Mons or even beyond. To ascertain this, the Ghlin drilling operation, some 6 km to the east of the St-Ghislain-Baudour zone, was set up at Mons. With aid from the European Commission, the Ghlin operation has confirmed the hopes placed in it, all of which tends to support the present report in which the investigations are described and the steps taken so far are discussed.

6684 **(EUR—8727) Community demonstration project: geothermal drilling at Jonzac-Charentes. Final drilling report.** (Commission of the European Communities, Luxembourg). 1983. 59p. (In French). (EUR—8727-FR). NTIS, PC E04/MF E04.

The report on the drilling of the Jonzac GJNC 1 well is divided into three sections. Section A covers the technical side of the drilling operations giving a daily record of the work carried out. Section B deals with the production and bed evaluation tests carried out on the Trias and Lias reservoirs after the drilling operation. The Trias reservoir was put into production during the initial program. As its production fell short of expectations, the Lias reservoir was used, but this gave negative results and was non-productive. Section C is concerned with the geological aspects of the operation.

6685 **(EUR—8728) Community demonstration project: geothermal exploration drilling at Rheims-Murigny. Final drilling report.** (Commission of the European Communities, Luxembourg). 1983. 62p. (In French). (EUR—8728-FR). NTIS, PC E04/MF E04.

A borehole 1,542 m deep was drilled in 1981 near Rheims in France in order to investigate the possible exploitation of the geothermal fluids trapped in the sub-surface geological strata. The formations encountered during the drilling are described together with tests, analyses, drilling data, and a production test at the close of the drilling operation. The nature of the rocks and of the fluid indicate that there will be limits as to what use can be made of the geothermal reservoir.

6686 **(EUR—8729) Community demonstration project. Geothermal drilling at Strasbourg. Final drilling report.** (Commission of the European Communities, Luxembourg). 1983. 109p. (In French). (EUR—8729-FR). NTIS, PC E06/MF E06.

A study of a geothermal drilling project at Cronenbourg was undertaken by SOCALMIG at the request of the Commission with the aim of assessing the characteristics of the borehole and advising on the exploitation of the aquifer. The study was mainly concerned with the geothermal reservoir in the lower Triassic sandstone (Buntsandstein formation) and dealt with: (1) a critical examination of existing documents, (2) an examination of diagraphs and the reinterpretation of output tests, (3) the determination of the characteristics of the formation when drilling was stopped at 3,200 m and (4) the determination of the drilling process when longer-term experiments involving air injection are conducted.

6687 **(EUR—8730) Community demonstration project: geothermal drilling at Clermont-Ferrand. Final drilling report.** (Commission of the European Communities, Luxembourg). 1983. 61p. (In French). (EUR—8730-FR). NTIS, PC E04/MF E04.

Two wells have been drilled at Clermont-Ferrand with the aim of using the heat from the geothermal reservoir to supply 2,500 homes and other buildings. This project requires an output from the production well of 70 cu m/h of water at 95 degrees C. Results, however, showed a production capacity of only 25 cu m/h, a well bottom temperature of 98 degrees C, and a well head temperature between 85 and 90 degrees C. The objective of the project was not, therefore, achieved.

6688 **(EUR—8736) Community demonstration project: geothermal well at Aars. Final drilling report.** (Commission of the European Communities, Luxembourg). 1983. 179p. (EUR—8736-EN). NTIS, PC E08/MF E08.

In 1978 and 1979 a borehole 3,396 m deep was drilled at Aars, Jutland, Denmark, in order to investigate the possibilities of hot-water production from sandstone layers holding geothermal fluids at a temperature of about 105 degrees C and to determine the conditions for geothermal energy exploitation. The detailed drilling history, well evaluation, and the results of reservoir investigations are reported, which include a chemical analysis of the brine and studies of scale formation and corrosion.

6689 **(EUR—8765) Determination of local seismicity during operations of production and geothermal fluid reinjection in the Cesano area.** (Commission of the European Communities, Luxembourg). 1983. 77p. (EUR—8765-EN). NTIS, PC E05/MF E05.

The aim of the contract was to correlate induced seismic activity and brine reinjection in the Cesano area. A complete absence of signals made this correlation impossible. The investigations were shifted to Latera where reinjection in well Latera 1 was monitored. A test was carried out with a flow rate of approximately 100 m cu/h. The pressure variations at well-head and the time distribution of the microseismicity detected are reported. A total of 148 events were recorded that can be clearly correlated with the operations carried out. The microearthquakes recorded always exhibited close analogies concerning signal frequency, amplitude and polarity of the first arrivals. The foci were located in the immediate vicinity of the well at a depth of 0.7 to 2.7 km. The maximum magnitude that was measured was 0.4. The use of the integrative three-component stations with digital recording made it possible to perform some interesting and advanced analyses on the signals. It was possible to estimate the corner frequency of the spectrum of displacement of the P phase and therefore to determine the main parameters at the source such as seismic moment, source radius, stress drip and strain release. Even more important was the contribution that the integra-

tive stations, placed in the vicinity of the reinjection well, gave in determining the hypocenter and in the solution of the focal mechanisms.

6690 **(NP—5770109) Active audiomagnetotellurics. A method to determine background conductivity, including model calculations and an application to the Toscana geothermal anomaly.** Otten, J. (Technische Univ. Braunschweig (Germany, F.R.). Naturwissenschaftliche Fakultaet). 22 May 1984. 154p. (In German). NTIS (US Sales Only), PC A08/MF A01. File Number DE85770109.

Theory and practice of active magnetotellurics are discussed. The new measuring system consists of a receiver station and a transmitter station at a distance of 2 to 10 km, where a.c. currents, typically of 10 A, with frequencies of 0.01 to 2500 Hz, are fed into an electric dipole about 300 m long. The artificial electromagnetic fields thus generated are measured in the receiver station by means of two orthogonal electric dipoles and a three-axial induction coil magnetometer. Model calculations are carried out for the electric and magnetic fields of an electric dipoler over a threefold stratified half-space. The calculations are based on the Sommerfeld theory, converted into simple expressions suitable for numerical calculations. The characteristic behaviour of AAMT phase curves was illustrated by examples. The model calculations were applied in the evaluation of measurements carried out in October 1981 in the geothermal anomaly of Travale-Radicondoli (Toscana, Italy).

6691 **Location of hydraulic fractures using microseismic techniques.** Albright, J.N.; Pearson, C.F. *Society of Petroleum Engineers of A.I.M.E. (American Institute of Mining, Metallurgical and Petroleum Engineers), Paper;* No. SPE-9509, 10(1980). (CONF-800931—).

From 55. Society of Petroleum Engineers of AIME annual technical conference and exhibition; Dallas, TX, USA (21 Sep 1980).

Microearthquakes with magnitudes ranging between -6 and -2 have been observed in 3 successive massive injections of water at the US Department of Energy (DOE) hot dry rock geothermal energy demonstration site at Fenton Hill, New Mexico. The injection was part of a program to increase the heat transfer area of hydraulic fractures and to decrease the flow-through impedance between wells. The microearthquakes were used in mapping the location of the extended hydraulic fractures. Failure resulting from increased pore pressure is a likely cause for the microearthquakes. Knowledge of the failure criterion for the reservoir rocks makes possible the calculation of the pore pressure increases necessary for failure. At Fenton Hill it appears that pressures 20 bars above hydrostatic are necessary. For this hypothesis of microearthquake occurrence to hold, the effective reservoir permeability must be 4 orders of magnitude above that for the bulk rock. 12 references.

## 1504 Legal And Institutional Aspects

6692 (EPRI-AP—3686, pp 6.16-6.20) **Findings of US Senate hearings on geothermal development in Nevada.** Laszlo, J. (United States Senate, Washington, DC). Aug 1984. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920020. (CONF-8406201—).

From 8. annual geothermal conference and workshop; Seattle, WA, USA (25 Jun 1984).

The Energy and Mineral Resource Subcommittee of the Energy and Natural Resources Committee of the US Senate conducted a general oversight field hearing in Reno, Nevada on April 17, 1984. The purpose of the hearing was to receive testimony for the use of the Senate regarding the current state of geothermal development in Nevada's Great Basin, and any obstacles in the way of accelerating such development. The witnesses represented a broad spectrum which included state and federal government agencies, developers, utilities and various groups involved with direct use applications. A full witness list is given. A copy of the hearing transcript with the written statements of all the witnesses can be obtained from the Energy and Natural Resources Committee of the Senate. The key findings of the hearing are summarized.

## 1506 Environmental Aspects And Waste Disposal

*REFER ALSO TO CITATION(S) 1506006728*

6693 (EPRI-AP—3686, pp 5.7-5.12) **Cerro Prieto field test of $H_2S$ removal by upstream reboiling.** Angulo, R.; Lam, L.; Gonzalez, J.; Mulas, P. (Instituto de Investigaciones Electricas, Mexicali, Mexico). Aug 1984. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920020. (CONF-8406201—).

From 8. annual geothermal conference and workshop; Seattle, WA, USA (25 Jun 1984).

A previous EPRI project measured the removal of hydrogen sulfide ($H_2S$) gas from geothermal steam upstream of the turbine. Those tests, completed early in 1980, achieved $H_2S$ removal efficiency above 90% and heat transfer performance good enough to indicate that the upstream reboiler would be competitive with other $H_2S$ removal systems. In order to test the process over a wider range of conditions, EPRI has contracted with the Instituto de Investigaciones Electricas (IIE) for a cost-shared field test of the same reboiler vessel previously used at The Geysers. Under a separate contract awarded by EPRI, RP1197-5, Bechtel Group, Inc. designed and built a skid-mounted test system using the same reboiler vessel previously operated at The Geysers. This work was completed in November 1983, and the test unit has been operated by IIE at well M-42 of the Cerro Prieto geothermal field since January 1984. As of May 31, 1984, measurements have been made at 60 of the 76 operating conditions specified in the test plan for the project. Some preliminary results are presented.

6694 **(PNL—4767) Geothermal injection treatment: process chemistry, field experiences, and design options.** Kindle, C.H.; Mercer, B.W.; Elmore, R.P.; Blair, S.C.; Myers, D.A. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1984. Contract AC06-76RL01830. 262p. NTIS, PC A12/MF A01; 1; GPO Dep. File Number DE85002873.

The successful development of geothermal reservoirs to generate electric power will require the injection disposal of approximately 700,000 gal/h (2.6 x $10^6$ l/h) of heat-depleted brine for every 50,000 kW of generating capacity. To maintain injectability, the spent brine must be compatible with the receiving formation. The factors that influence this brine/formation compatibility and tests to quantify them are discussed in this report. Some form of treatment will be necessary prior to injection for most situations; the process chemistry involved to avoid and/or accelerate the formation of precipitate particles is also discussed. The treatment processes, either avoidance or controlled precipitation approaches, are described in terms of their principles and demonstrated applications in the geothermal field and, when such experience is limited, in other industrial use. Monitoring techniques for tracking particulate growth, the effect of process parameters on corrosion and well injectability are presented. Examples of brine injection, preinjection treatment, and recovery from injectivity loss are examined and related to the aspects listed above.

6695 **(UCID—20156) Evaluation of subsurface fracture geometry using fluid pressure response to solid earth tidal strain.** Hanson, J.M. (Lawrence Livermore National Lab., CA (USA); Terra Tek Research, Salt Lake City, UT (USA)). Sep 1984. Contract W-7405-ENG-48. 140p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE85003294.

The nature of solid earth tidal strain and surface load deformation due to the influence of gravitational forces and barometric pressure loading are discussed. The pore pressure response to these types of deformation is investigated in detail, including the cases of a confined aquifer intersected by a well and a discrete fracture intersected by a well. The integration of the tidal response method with conventional pump tests in order to independently calculate the hydraulic parameters of the fracture-formation system is discussed. How advanced spectral analysis methods, coupled with correlation analysis can be used to extract the tidal response signals from the pressure record is shown. Uncertainties in the signals are estimated using various information-theoretic methods in order to place a confidence level at which we can safely assume that the measured signal is indeed of tidal origin. A detailed case study of

the method carried out at the Raft River Geothermal Reservoir in Idaho is presented. All of the analyzed tidal data is presented and the results of the computed fracture orientation using the solid earth tidal strain approach are compared with the extensive field work carried out at Raft River over the past decade. The direction that future work in the continuing development of this technology should take is discussed, including: (1) the present need for an expanded data base for the confirmation of present tidal strain response models, and (2) improvement in response models.

## 1507 By-products

*REFER ALSO TO CITATION(S) 1507006728*

6696 **(PB—84-224500) Recovering lithium chloride from a geothermal brine. Report of investigations/1984.** Schultze, L.E.; Bauer, D.J. (Bureau of Mines, Reno, NV (USA). Reno Research Center). 1984. 20p. (BM-RI—8883). NTIS, PC A02/MF A01.

Library of Congress catalog card No. 84-600071.

The Bureau of Mines has devised techniques to recover lithium from geothermal brines as the chloride. More than 99 pct of the lithium was precipitated from a brine containing 170 mg/L Li by adding a solution of A1C13 and increasing the pH to 7.5 with lime slurry. The Li-Al precipitate was dissolved in HCl and sparged with gaseous HC1 to recover the A1C13; this resulted in a solution containing LiCl and CaC12. The solution was evaporated at 100C to obtain a mixture of the chlorides from which 97 pct of the lithium was recovered and 90 pct of the calcium was rejected by leaching with tetrahydrofuran. The LiC1 recovered by evaporation of the tetrahydrofuran was purified by dissolution in water and treatment with oxalic acid. The final LiC1 solution contained 89 pct of the lithium originally present in the brine and had a purity of 99.9 pct.

## 1508 Geothermal Power Plants

*REFER ALSO TO CITATION(S) 1508006661, 6663, 6664, 6665, 6667, 6675, 6693*

6697 **(DOE/RA/50241—T1) Thermophysical properties of working fluids for binary geothermal cycles. Final report.** Diller, D.E.; Gallagher, J.S.; Kamgar-Parsi, B.; Morrison, G.; Levelt Sengers, J.M.H.; Sengers, J.V.; Van Poolen, L.J.; Waxman, M. (National Bureau of Standards, Boulder, CO (USA). Chemical Engineering Science Div.; National Bureau of Standards, Washington, DC (USA). Thermophysics Div.; Maryland Univ., College Park (USA). Inst. for Physical Science and Technology). Jul 1984. Contract AT01-80RA50241. 150p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE85000385.

The following are presented: thermodynamic properties of isobutane and isobutane-isopentane mixtures; a scaled fundamental equation for mixtures of isobutane and isopentane near gas-liquid critical line; and viscosities of hydrocarbons and their mixtures. (MHR)

6698 (EPRI-AP—3686, pp 4.27-4.31) **Utility industry estimates of geothermal energy.** Kruger, P.; Roberts, V. (Electric Power Research Inst., Palo Alto, CA). Aug 1984. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920020. (CONF-8406201—).

From 8. annual geothermal conference and workshop; Seattle, WA, USA (25 Jun 1984).

The Electric Power Research Institute (EPRI) has completed its eighth annual survey of the North American electric utilities interested in geothermal energy as a source of electric power. The survey sent to each utility requests a best estimate of expected additions of geothermal energy plants through four time periods, 1985, 1990, 1995, and 2000. The results of the EPRI survey and NERC data sources are examined and the average expectation values for installed geothermal capacity for three time periods by a number of regression models are estimated.

6699 (EPRI-AP—3686, pp 5.23-5.32) **Mechanical removal of scale from geothermal heat exchangers and pipelines.** Torbin, R.N.; Bell, R.J. (Foster-Miller, Inc., Waltham, MA). Aug 1984. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920020. (CONF-8406201—).

From 8. annual geothermal conference and workshop; Seattle, WA, USA (25 Jun 1984).

Fouling/scaling of heat exchanger surfaces, regardless of the tube side fluid, is one of the most significant causes of poor heat transfer performance. In heat exchangers utilizing water on the tube side, fouling/scale removal has been addressed with a number of commercially available on-line and off-line mechanical cleaning techniques. For binary cycle geothermal power plants, fouling/scaling takes on different, more difficult characteristics. The utility now encounters a heavy, hard brine scale rather than the relatively thin and often fragile fouling films found in water type heat exchangers. The operating conditions of a binary cycle (high temperatures and pressures, and rapid scaling make the direct application of conventional cleaning techniques inappropriate. The degree of cleaning represents the real difference between conventional steam and geothermal power plants. Where cleaning may be required every few months in a conventional plant, cleaning is needed on a much more frequent schedule in some geothermal plants. Methods for removing scale from geothermal heat exchanges are discussed.

6700 (EPRI-AP—3686, pp 4.9-4.19) **EPRI geothermal wellhead projects.** Hughes, E.E. (Electric Power Research Inst., Palo Alto, CA). Aug 1984. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920020. (CONF-8406201—).

From 8. annual geothermal conference and workshop; Seattle, WA, USA (25 Jun 1984).

The results from one recent EPRI wellhead project and an overview of the wellhead conversion subprogram are presented. The selected recent project is a thermodynamic analysis of 240 different power cycles suitable for wellhead plants. The cases were derived from consideration of 5 different resource temperatures, 6 different types of cycles, and 12 different working fluids. The analysis of cycles is one of a group of projects involving development of wellhead power systems.

6701 (EPRI-AP—3686, pp 4.25-4.26) **Heber Binary Project and related efforts.** Bigger, J.E. (Electric Power Research Inst., Palo Alto, CA). Aug 1984. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920020. (CONF-8406201—).

From 8. annual geothermal conference and workshop; Seattle, WA, USA (25 Jun 1984).

Design information and construction progress on the Heber Binary Project is given. In addition to the direct financial support to the Project made by EPRI as a direct participant, a number of additional efforts are planned and underway to support the Project and the continued development of binary-cycle technology. These include: (1) brine chemistry analysis, (2) project startup support, (3) project documentation support, and (4) downwell pump reliability demonstration. These projects are briefly described.

6702 (EPRI-AP—3686, pp 5.1-5.6) **Chemistry and scale: their effects on performance at Hawaii's 3MW power plant, EPRI Research Project 1195-12.** Thomas, D. (Univ. of Hawaii at Manoa, Honolulu). Aug 1984. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920020. (CONF-8406201—).

From 8. annual geothermal conference and workshop; Seattle, WA, USA (25 Jun 1984).

The HGP-A well, located on the East Rift Zone of Kilauea Volcano, was completed in 1976 to a depth of 1966 m and has a measured bottom hole temperature, under static conditions, of 358°C. The current casing configuration for the well is solid 17.78 cm casing to a depth of approximately 915 m and 17.78 cm slotted liner from that depth to bottom hole. Production is believed to come primarily from aquifers located at 1372 m, 1768 m and bottom hole. The well is capable of producing approximately 49,900 kg/hr of a mixed phase fluid (57% liquid, 43% steam) at a wellhead pressure of 1222 kPaa. In August 1983 a turbine inspec-

tion and overhaul program was undertaken to evaluate scale and corrosion processes generated at the power plant by the geothermal fluids produced by the HGP-A well. The results of this effort indicated that two types of scale deposition have occurred: silicate and metal sulfide. The deposition of these two scale types occur simultaneously in a few areas but are generally found to predominate in different systems power of the power plant facility. The data accumulated to the present time suggest that the major chemical controls on scale formation at the HGP-A facility are brine salinity and pH and the intermittent access of air (oxygen) to the steam system.

6703 (EPRI-AP—3686, pp 5.17-5.18) **Design of a hybrid power plant for the Pleasant Bayou geopressured resource.** Campbell, R.G. (Ben Holt Co., Pasadena, CA). Aug 1984. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920020. (CONF-8406201—).

From 8. annual geothermal conference and workshop; Seattle, WA, USA (25 Jun 1984).

Work on a multiparticipant project to demonstrate electricity generation using a hybrid scheme on a geopressured resource is described. The overall goal of this project was to build and operate a pilot plant producing electricity from DOE's geopressured well Pleasant Bayou No. 2 in Texas. High pressure fluid at the wellhead will be expanded through a pressure reduction turbine or a throttle valve. Methane liberated in the expansion will fuel a gas engine driving a generator. The residual geothermal brine will be the primary heat source for a binary cycle with propane as the probable working fluid. Additional heat will be provided to the binary cycle from the gas engine exhaust and jacket cooling. This scheme is considered to be one of the most promising means of electricity generation for geopressured resources. The design of the binary cycle portion of the plant is described and the installed cost for the complete hybrid power system estimated.

6704 (EPRI-AP—3686, pp 6.21-6.30) **MAGMAMAX Power Plant: success at East Mesa.** Hinrichs, T.C. (Magma Power Co., Escondido, CA). Aug 1984. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920020. (CONF-8406201—).

From 8. annual geothermal conference and workshop; Seattle, WA, USA (25 Jun 1984).

The history of the development of the MAGMAMAX power process is presented. A specific design for a proposed power plant employing the MAGMAMAX concept is discussed. Construction of the plant started in January of 1978 and initial operations began in September 1979. Two years of intermittent operation were experienced with operation problems developing around the main turbine and the brine/isobutane heat exchangers. Despite the operational problems, it is concluded that the plant has been a technical success. Modifications to the plant are planned to increase its performance and efficiency.

6705 (EPRI-AP—3686, pp 6.31-6.34) **DOE Heat Cycle Research program results.** Whitbeck, J.F. (EG and G Idaho, Inc., Idaho Falls). Aug 1984. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920020. (CONF-8406201—). Contract AC07-76ID01570.

From 8. annual geothermal conference and workshop; Seattle, WA, USA (25 Jun 1984).

The Heat Cycle Research program is discussed. This program is primarily directed toward the improved utilization of moderate temperature resources and thus emphasizes the binary cycle. The program combines analytical definition of potential improvements to the binary cycles with experimental verification. Recent efforts have included investigation of turbine expansion through the two-phase region, the use of working fluid mixtures in direct contact heat exchangers and as working fluids in supercritical cycles with integral condensing. It is the aim of the program to develop the understanding and technology necessary so that these techniques can be applied to the fullest extent and their limitations determined. Since improvements in brine utilization of up to 30% may be possible through a combination of effects, the impact on the utilization of the moderate temperature resources may be significant. The present program is outlined, the mobile Heat Cycle Research Facility (HCRF) is described, and a summary of some of the preliminary results of the testing program to date are presented.

6706 (EPRI-AP—3686, pp 5.33-5.34) **Rotary separator turbine for wellhead power production.** Cerini, D.J.; Record, J. (Transamerica Delaval, Inc., Santa Monica, CA). Aug 1984. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920020. (CONF-8406201—).

From 8. annual geothermal conference and workshop; Seattle, WA, USA (25 Jun 1984).

A rotary separator turbine was designed for operation as a wellhead steam-liquid separator with electrical power production from the separated liquid. The unit was designed to accept the full flow from one geothermal well, for resources above 320°F. In 1981-82, the first unit was fabricated and tested to establish performance characteristics. The tests took place at the Roosevelt Hot Springs resource. The operation and performance of the unit are described.

6707 (EPRI-AP—3686, pp 1.6-1.15) **Growth in geothermal power generation capacity and DOE's supporting role.** Mock, J.E.; Toms, R.S.H.; Beeland, G. (Dept. of Energy, Washington, DC). Aug 1984. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920020. (CONF-8406201—).

From 8. annual geothermal conference and workshop; Seattle, WA, USA (25 Jun 1984).

The US Department of Energy's role in the development of geothermal resources is discussed. Some research and development efforts in which members of the geothermal industry have participated are also discussed. The four major impediments to geothermal energy development are lack of confidence in reservoir definition, drilling costs, capital costs of power plant construction, and uncertain behavior of injected fluids.

6708 (EPRI-AP—3686, pp 2.1-2.6) **Heber Binary Project: binary cycle geothermal demonstration power plant.** Lacy, R.G.; Nelson, T.T. (San Diego Gas and Electric Co., CA). Aug 1984. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920020. (CONF-8406201—).

From 8. annual geothermal conference and workshop; Seattle, WA, USA (25 Jun 1984).

The objectives of the Heber Binary Project are to demonstrate the potential of moderate-temperature (below 410°F) geothermal energy to produce economic electric power with binary cycle conversion technology, and equipment performance, reservoir performance, and environmental acceptability of such plants. The plant will be the first large-scale power generating facility in the world utilizing the binary conversion process. The power cycle, plant design, turbine generators, heat exchangers and condensers, materials selection, and heat sales contract are described.

6709 (EPRI-AP—3686, pp 2.7-2.19) **Heber double-flash geothermal power plant: a fast-track project.** Willett, R.F.; Bickerstaffe, J.A.; Flower, J.E. (Gibbs and Hill, Inc., San Jose, CA). Aug 1984. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920020. (CONF-8406201—).

From 8. annual geothermal conference and workshop; Seattle, WA, USA (25 Jun 1984).

In 1977 discussions were initiated to develop a 52 MW commercial scale, double-flash cycle geothermal power plant in the Heber Known Geothermal Resource Area. The scope of the project is discussed along with design and construction problems. The plant control philosophy using a microprocessor-based distributed control system is described. The technical parameters for the plant, i.e., brine supply system, steam turbine, generator, and heat rejection system are presented and discussed.

6710 (EPRI-AP—3686, pp 3.1-3.4) **SMUD geothermal activity.** Hansen, P. (Sacramento Municipal Utility District, CA). Aug 1984. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920020. (CONF-8406201—).

From 8. annual geothermal conference and workshop; Seattle, WA, USA (25 Jun 1984).

The Sacramento Municipal Utility District (SMUD) began operating its first geothermal power plant, SMUDGEO #1 in De-

cember of 1983. This 72 MW plant is located in the Geysers area of Northern California. SMUD is continuing development in the Geysers as a member of the Central California Power Agency No. 1 (CCPA No. 1). CCPA No. 1 is developing a steam field in the northern end of the Geysers and has filed an Application for Certification with the California Energy Commission in April of 1984, to build the 65 MW Coldwater Creek Geothermal Power Plant. The application also allows for a second 65 MW unit to be installed at the same site. On this project CCPA No.1 is taking a more active role in the development of the steam field than has been customary for power plant owners in the Geysers. SMUD, as part of the Geysers Public Power Line group (GPPL), has also filed a notice of intent to construct a transmission line to bring power to the Sacramento Valley from existing and future power plants of GPPL members. Through its involvement with CCPA No. 1 and GPPL, SMUD is continuing to develop geothermal energy as a practical means of meeting future generating requirements.

6711 (EPRI-AP—3686, pp 3.26-3.28) **SCE geothermal program: 1984 update.** Crane, G.K. (Southern California Edison Co., Rosemead). Aug 1984. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920020. (CONF-8406201—).

From 8. annual geothermal conference and workshop; Seattle, WA, USA (25 Jun 1984).

Southern California Edison's geothermal program continues to progress. Substantial knowledge and kilowatt-hours are being generated at the Salton Sea and Brawley pilot plants. Several third-party project electricity purchase contracts were executed with ground having been broken on some of these projects. Discussions and negotiations continue with other QFs, in several geographic areas including the Imperial Valley, Long Valley and Nevada. Studies of alternative plant cycles, sizes and configurations continue. It is believed that the current goal of 350 MW of geothermal capacity on-line by 1992 will be achieved.

6712 (EPRI-AP—3686, pp 3.29-3.32) **Capital cost and performance of alternative wellhead power systems.** Todd, J.H. (Southern California Edison Co., Rosemead). Aug 1984. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920020. (CONF-8406201—).

From 8. annual geothermal conference and workshop; Seattle, WA, USA (25 Jun 1984).

Much interest has been shown by contractors, equipment suppliers and the utilities, in the use of geothermal energy to generate electricity. The interest has spawned many ideas on how this could best be accomplished. Various conversion concepts and unit sizes were offered by enterprising individuals as well as corporations, each offering their unique benefits. As the various concepts matured, the question of unit size gained more interest. The small wellhead units were promoted by some while the larger central units were viewed by others as the more economically viable way to develop large geothermal fields. A study was conducted to determine performance and cost trends for various size wellhead units. The study considered various concepts and unit sizes for different resource temperatures. The objectives, study methodology and scope of the project are presented.

6713 (EPRI-AP—3686, pp 3.39-3.41) **Transportation: a major concern for geothermal development.** Lavach, M.T. (San Diego Gas and Electric Co., CA). Aug 1984. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920020. (CONF-8406201—).

From 8. annual geothermal conference and workshop; Seattle, WA, USA (25 Jun 1984).

The local market for electric power near the geothermal resource is usually insufficient to support major development. The cost of transporting power is sometimes overlooked by geothermal developers. Major high voltage transmission lines, including substations, can cost in the neighborhood of $1 million/mile. Construction problems and costs associated with power transmission lines in the Imperial Valley in California are discussed.

6714 (EPRI-AP—3686, pp 3.5-3.10) **Description of the low solids $H_2S$ abatement process for units 1, 2, 7, and 8, The Geysers Power Plant.** Dorighi, G.P.; Henderson, J.M. (Pacific Gas and Electric Co., San Ramon, CA). Aug 1984. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920020. (CONF-8406201—).

From 8. annual geothermal conference and workshop; Seattle, WA, USA (25 Jun 1984).

The geothermal steam produced at The Geysers contains several noncondensible gases, including hydrogen sulfide ($H_2S$). The $H_2S$ concentration has ranged from 32 up to nearly 1000 ppm (parts per million of steam by weight). $H_2S$ has a pronounced characteristic odor, and PGandE has for several years been developing methods to reduce the emissions of $H_2S$ from the power generating units to the atmosphere. A number of methods have been tried, some of which are currently in use. The most recent one to be developed utilizes thermal incineration of the vent gas $H_2S$ along with chelated iron oxidation of the $H_2S$ in the circulating water. The process, presently in commercial operation at Units 1, 2, 7, and 8, The Geysers Power Plant, is described.

6715 (EPRI-AP—3686, pp 3.17-3.19) **Dry natural draft cooling tower for Binary Geothermal Power Plants.** Blockley, W. (Sierra Pacific Power Co., Reno, NV). Aug 1984. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920020. (CONF-8406201—).

From 8. annual geothermal conference and workshop; Seattle, WA, USA (25 Jun 1984).

Binary Geothermal Power Plants, with their relatively high plant cooling requirements per kWh of power output, could be made more efficient if a dry natural draft cooling tower were used which didn't have the parasitic power requirement associated with the fans and pumps in conventional forced convention towers. Dry natural draft cooling towers are not common, and a dry natural draft cooling tower adaptable for plants in the 5.25 MW/sub e/ isn't practical if conventional construction techniques are considered. Design and construction considerations for such a cooling tower are presented.

6716 (EPRI-AP—3686, pp 3.20-3.25) **Geothermal steam condensate for cooling water: Salton Sea and Brawley Geothermal Pilot Plants.** Moss, E. (Southern California Edison Co., Rosemead). Aug 1984. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920020. (CONF-8406201—).

From 8. annual geothermal conference and workshop; Seattle, WA, USA (25 Jun 1984).

The 10 MW Salton Sea and 10 MW Brawley Geothermal Pilot plants are surrounded by farms in the Imperial Valley of California. Demonstrating that geothermal development is compatible with agri-business has been an objective since the beginning of our pilot plant projects. Both facilities were designed to use irrigation water from the Imperial Irrigation District for cooling water. However, the original water agreements with IID allow water for five years with the stipulation that alternate sources of water be investigated. Both facilities have operated on condensate for cooling water. The Salton Sea facility has operated for over six months and Brawley for one month. The initial results at each facility are presented.

## 1509 Geothermal Engineering

*REFER ALSO TO CITATION(S) 1509006699, 6701, 6702, 6728*

6717 (EPRI-AP—3686, pp 4.32-4.34) **Research and development projects, June 1984: Geothermal Power Systems Program.** Aug 1984. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920020. (CONF-8406201—).

From 8. annual geothermal conference and workshop; Seattle, WA, USA (25 Jun 1984).

A listing of the EPRI research and development projects in the Geothermal Power Systems Program is presented. The listing contains 27 projects; a brief description of each project is given.

6718 (EPRI-AP—3686, pp 5.13-5.16) **Mobile geothermal laboratory operations: 1982-1984.** McLearn, M.E. (Rockwell International, Newbury Park, CA). Aug 1984. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920020. (CONF-8406201—).

From 8. annual geothermal conference and workshop; Seattle, WA, USA (25 Jun 1984).

Development of geothermal power in the US has created a continuous need for reliable, well-documented physical and chemical data. The EPRI Mobile Geothermal Laboratory has worked for the past four years to support geothermal power development from initial resource assessment through operating power plant monitoring. Although both the projects of the mobile laboratory and its capabilities have been broadened, the original objectives of the project remain the same: to establish standard procedures for physical and chemical measurements on geothermal systems; to generate extensive and reliable physical-chemical characterizations of geothermal resources suitable for inclusion in the EPRI brine data base; and to support EPRI projects and utility field tests with physical and chemical information. The Mobile Geothermal Laboratory continues to provide to the industry a flexible capability for the analysis of brine, steam condensate, noncondensable gases, and geothermal solids. Activities, observations, and changes for the period 1982-84 are presented.

6719 (EPRI-AP—3686, pp 4.20-4.24) **Geothermal Chemistry Subprogram.** Jackson, J.M. (Electric Power Research Inst., Palo Alto, CA). Aug 1984. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920020. (CONF-8406201—).

From 8. annual geothermal conference and workshop; Seattle, WA, USA (25 Jun 1984).

The objectives of the research conducted under the Geothermal Chemistry Subprogram are to understand and control the behavior of minerals contained in geothermal fluids. Because all geothermal fluids contain dissolved minerals, this subprogram has application to all geothermal developments. Research in this subprogram is summarized.

6720 (EUR—8716) **Community demonstration project: geothermal drilling at Pessac Bordeaux. Final drilling report.** Platel, J.P.; Teissier, J.L. (Commission of the European Communities, Luxembourg). 1983. 59p. (In French). (EUR—8716-FR). NTIS, PC E04/MF E04.

GBDX3 is the third geothermal well to be opened up in the area of the urban district of Bordeaux. Its aim is to give access to the geothermal resource of the Cenomano-Turonien water layer discovered during prospecting for oil. Drilling operations are detailed and geological and geochemical features of the well are described. The geothermal water layer was found to have a salt content of 0.360 g/l. During pumping tests, a well head temperature of 48.4 degrees C and an output of 193 cu m/h were recorded.

6721 (EUR—8719) **Community demonstration project: geothermal pair of wells at latera. Final drilling report .** (Commission of the European Communities, Luxembourg). 1983. 144p. (In English and Italian). (EUR—8719-EN/IT). NTIS, PC E07/MF E07.

Drilling operations and stratigraphy are reported for two wells at the same site (drift 340 m at 1,369 m depth). Temperature profiles are given, and for one well, specific heats, thermal conductivities, and densities are measured in a series of cores taken down to 2,300 m. It is confirmed that the Mesozoic carbonate terrains in the Latera geothermal field are characterized by a wide diversity in permeability. It is suggested that the large quantities of fluid (e.g. 120 tons/hour, 198 degrees C at well head) which surfaced from the non-vertical well, come from a fracture system lying at greater depths. In contrast, the poor productivity of the vertical well is attributed to low permeability.

6722 (EUR—8725) **Community demonstration project: the geothermal doublet at Beauvais. Final drilling report.** (Commission of the European Communities, Luxembourg). 1983. 120p. (In French). (EUR—8725-FR). NTIS, PC E06/MF E06.

Twin wells were bored to the NE of Beauvais with the aim of exploiting the Dogger geothermal reservoir. Drilling reports for the production and the deviated injection wells record the sinking operation, the performance of the drilling equipment, the type and consumption of drilling mud, and the piping and cementing of the wells. Geological and geochemical examinations were carried out and the propensity for corrosion of the fabric of the well due to chemical, bacteriological, and mechanical action was examined. The production temperature at the well head was estimated using the method of Ramey. It is hoped that the geothermal energy from these wells can be used to heat 1200 homes and possibly a hospital.

6723 (SAND—84-1589) **Computer simulation of the cooling effect due to circulation in four geothermal well models.** Duda, L.E. (Sandia National Labs., Albuquerque, NM (USA)). Nov 1984. Contract AC04-76DP00789. 65p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85004356.

Computer calculations of wellbore transient temperatures, using the geothermal wellbore thermal simulator code GEOTEMP2, were made on four well models. The well models studied were from the Baca geothermal area, the East Mesa geothermal area, and a shallow and a deep well from the Salton Sea geothermal area. Calculations for one day of water circulation followed by one day of shut-in at flow rates of 100, 250, 500, and 1000 gpm were made to investigate the cooling effects produced by the circulation. Additional calculations were made using the Baca and Salton Sea well models. In the former, the effect on the cooling due to different soil thermal conductivity values and different circulating fluids (a high viscosity mud and air) were investigated. In the latter, the number of casings in the wellbore and the diameter of the tubing were notified. Plots of the calculated temperatures as a function of circulation and shut-in time and depth are given for each case.

6724 (SAND—84-7142) **Analytical and experimental study of the acoustics and the flow field characteristics of cavitating self-resonating water jets.** Chahine, G.L.; Genoux, P.F.; Johnson, V.E. Jr.; Frederick, G.S. (Tracor Hydronautics, Inc., Laurel, MD (USA)). Sep 1984. Contract AC04-76DP00789. 182p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE85003476.

Waterjet nozzles (STRATOJETS) have been developed which achieve passive structuring of cavitating submerged jets into discrete ring vortices, and which possess cavitation incipient numbers six times higher than obtained with conventional cavitating jet nozzles. In this study we developed analytical and numerical techniques and conducted experimental work to gain an understanding of the basic phenomena involved. The achievements are: (1) a thorough analysis of the acoustic dynamics of the feed pipe to the nozzle; (2) a theory for bubble ring growth and collapse; (3) a numerical model for jet simulation; (4) an experimental observation and analysis of candidate second-generation low-sigma STRATOJETS. From this study we can conclude that intensification of bubble ring collapse and design of highly resonant feed tubes can lead to improved drilling rates. The models here described are excellent tools to analyze the various parameters needed for STRATOJET optimizations. Further analysis is needed to introduce such important factors as viscosity, nozzle-jet interaction, and ring-target interaction, and to develop the jet simulation model to describe the important fine details of the flow field at the nozzle exit.

## 1510 Direct Energy Utilization

6725 (DOE/ID/12478—T6) **Geothermal feasibility study for Idaho State School and Hospital, Nampa, Idaho.** Balzhiser, J.K. (Balzhiser/Hubbard and Associates, Eugene, OR (USA)). Oct 1984. Contract FG07-83ID12478. 59p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85002355.

Apparently it is possible to obtain a geothermal source of water at about 3000 ft depth that should produce 500+ GPM at 160°F. The present steam and condensate lines are poorly insulated which adds to the heating costs and, in addition, the condensate lines are in poor condition. If this system is retained, it will cost upwards of $100,000 to replace these condensate lines. This cost should be considered as an off-set against the cost of the geother-

mal system. This was not included in the economic analysis simply because the cost for these repairs is next to impossible to predict with any accuracy. Changing over to geothermal hot water system will reduce the gas consumption by 75%. Most of the remaining gas use (steam) would be in the laundry and kitchen. In preparing this study, the assumption was made that most buildings that are presently using hot water could be heated with 155°F water. It is recommended that during the ensuing year the maintenance department be instructed to change the controls on several buildings to reduce the temperature of the hot water down to 155°F to see if comfort can be maintained at the lower setting. When this is done, the buildings should be maintained on a 24 hour basis at the daytime setting, that is, no night set back.

6726 **A geothermal district-heating assessment model for decision making.** Reisman, A.W. (Brookhaven National Laboratory, Upton, NY). *ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) Transactions;* **88**: 1297-1308(Jan 1982). (CONF-820112—).

From Semi-annual meeting of the American Society of Heating, Refrigerating, and Air Conditioning Engineers; Houston, TX, USA (24 Jan 1982).

District heating in the United States is currently undergoing a critical evaluation by government planners responsible for promoting energy self-reliance. Efficient use of energy and the possibility of utilizing domestic energy sources in place of foreign fuel are two of the potential benefits gained by the installation of a district heating system. As an added incentive, in many cases the unit cost of the district heat to the consumer will be low enough to promise dollar savings now, with the promise of even greater savings in the future if the cost of foreign oil and other fossil fuels continues to rise. The analyst in the district heating field must ask the questions "Where and under what conditions is a district heating system economically feasible? How much energy can be saved? Because district heating implementation is very strongly site-specific, it is not possible to answer these questions in a satisfactory way without examining energy supply and energy use patterns on a city by city basis. Therefore a tool is required which will allow a planner to utilize a large set of regional and site specific data in a fast, effective way to assess the potential for district heat with respect to energy savings, fuel switching, and economic feasibility. The results of applying the tool must be technically and economically reasonable.

6727 **GEOCITY: A computer model for systems analysis of geothermal district heating and cooling costs.** Bloomster, C.H.; Fassbender, L.L. (Pacific Northwest Laboratory, Richland, WA). *ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) Transactions;* **88**: 1309-1322(Jan 1982). (CONF-820112—).

From Semi-annual meeting of the American Society of Heating, Refrigerating, and Air Conditioning Engineers; Houston, TX, USA (24 Jan 1982).

GEOCITY is a computer simulation model developed to study the economics of district heating/cooling using geothermal energy. GEOCITY calculates the cost of district heating/cooling based on climate, population, resource characteristics, and financing conditions. The principal input variables are minimum and maximum temperatures, heating degree-days and cooling degree-hours, population size and density, resource temperature and distance from load center, housing type, and the interest rate. From this input data the model designs the transmission and district heating/cooling systems. From this design, GEOCITY calculates the capital and operating costs for the entire system, including the production and disposal of the geothermal water. The basis for the geothermal energy cost analysis is the unit cost of energy which will recover all the costs of production -- capital investment, operating expenses, taxes, and the specified rates of return on capital. The calculation of the unit cost of energy is based on life cycle costing and discounting cash flow analysis. A wide variation can be expected in the range of potential geothermal district heating and cooling costs. The range of costs is determined by the characteristics of the resource, the characteristics of the demand, and the distance separating the resource and the demand. In this paper, costs were developed for each of the main parts of the production process. The sensitivity of these costs to several significant parameters under a consistent set of assumptions were also determined.

### 1520 Geothermal Data And Theory

*REFER ALSO TO CITATION(S) 1520006718*

6728 **(DOE/SF/11520—T1) Geochemical engineering reference manual.** Owen, L.B.; Michels, D.E. (Terra Tek, Inc., Salt Lake City, UT (USA); Republic Geothermal, Inc., Santa Fe Springs, CA (USA)). Jan 1984. Contract AC03-81SF11520. 555p. NTIS, PC A24/MF A01; 1; GPO Dep. File Number DE85003246.

The following topics are included in this manual: physical and chemical properties of geothermal brine and steam, scale and solids control, processing spent brine for reinjection, control of noncondensable gas emissions, and goethermal mineral recovery. (MHR)

## 16 TIDAL AND WAVE POWER

### 1607 Tidal Power Plants

6729 **(PB—84-234111) Use of the describing function technique for estimating power output from a tidal barrage scheme.** Berry, P.E. (Central Electricity Generating Board, Southampton (UK). Technology Planning and Research Div.). 1982. 24p. (TF—425). NTIS, PC E03/MF E03.

The present study is an extension of the work of Count (1980) and Jefferys (1981) to wedge-shaped estuaries. The objective is to improve understanding of the dynamics of an estuary with a barrage particularly when the flow across the barrage is controlled in some way so as to improve power generation. This objective is achieved in the present work by constructing simple physical models of tidal estuaries for which approximate analytical solutions are obtained. The solutions obtained are then optimized numerically with respect to control variables such as to maximize power output. This optimization is shown to be reducible to a one parameter problem. (Copyright (c) Central Electricity Generating Board 1982.)

## 17 WIND ENERGY

### 1706 Wind Energy Engineering

6730 **(DOE/NASA—0330-1) Design and wind tunnel evaluation of a symmetric airfoil series for large wind turbine applications.** Gregorek, G.M. (Ohio State Univ., Columbus (USA)). May 1984. Contract AI01-76ET20320. 25p. (NASA-CR—174764). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003054.

Using the Eppler analytic design methodology, a family of symmetric airfoils with thickness to chord ratios of 0.21, 0.25, and 0.29 has been designed for applications to large wind turbines. The airfoil series, designed for Reynolds numbers above $4 \times 10^6$, has a contour that maintains its thickness to the 0.7 chord position, allowing use of a deep aft spar for structural integrity. Wind tunnel tests of the 21 percent thick airfoil conducted in The Ohio State University Airfoil Test Facilities at $M = 0.25$ and $Re = 2$, 4, and $8 \times 10^6$ showed good agreement with predicted surface pressures and lift and drag coefficients when the angle of attack was low and the Reynolds number was $8 \times 10^6$. At the lowest Reynolds number, both the measured lift curve slope and the maximum lift coefficient differ significantly from theory. In the post-stall region, agreement with theory and experiment is poor, at all Reynolds numbers, verifying the need for improved analytic methods in this important flow regime.

6731 **(NP—5900395) Renewable energy: energy from wind.** (Florida State Energy Office, Tallahassee (USA)). Aug 1983. 25p. Governors Energy Office, The Capital, Tallahassee, FL 32301. File Number TI85900395.

Capturing the energy of the wind is an attractive means to supply renewable energy. The technology and systems for wind energy conversion are available commercially. WECS are economi-

cally competitive where provided. Although federal involvement in these activities is being reduced, major private efforts are underway to develop large-scale wind energy systems, particularly in the western states. The federal Public Utility Regulatory Policy Act will continue to provide incentives for small wind system power producers by requiring utilities to purchase excess electricity these systems generate. In Florida, the statewide wind resource probably will be inadequate to support widespread, commercially successful wind energy development in the near future. Coastal sites, particularly in the Florida Keys, and remote inland locations hold the greatest promise for wind energy systems. The small number of operating wind energy systems in the state are found in these locations. Improved technologies that allow economical power production in low wind speeds may improve the attractiveness of using Florida winds to prodice power. Research in such technologies will be of great interest in Florida, but investments must be weighed carefully against those in other renewable resources available in the state.

6732 **(SERI/TP—217-2530) Aerodynamic research efforts at SERI Wind Energy Research Center at Rocky Flats.** Tangler, J.L. (Solar Energy Research Inst., Golden, CO (USA)). Oct 1984. Contract AC02-83CH10093. 9p. (CONF-841071—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85000529.

From European wind energy conference and exhibition; Hamburg, F.R. Germany (23 Oct 1984).

The Solar Energy Research Institute (SERI) under contract to the US Department of Energy (DOE) conducts in-house and subcontracted aerodynamic research studies. These efforts deal mainly with performance prediction and enhancement of horizontal axis wind turbines (HAWT's). Two levels of performance prediction theory are currently being used and refined while performance enhancement is being pursued through the development of new special purpose airfoils. A general purpose blade-element/momentum code (PROPSH) has been developed for rapid parametric studies and for use in annual energy calculations. A desirable feature of this code is a post-stall airfoil data synthesization routine that accounts for blade aspect ratio effects. A version of the performance code is also being developed to provide a better determination of dynamic stall effects on blade loads and performance as influenced by machine yaw angle, unsteady winds, tower shadow, and wind shear. For detailed wind turbine blade optimization, a more sophisticated lifting-surface/prescribed-wake analysis has recently been developed. This computer code is a transfer of current state-of-the-art helicopter theory into a wind turbine design analysis. The special purpose airfoil design effort is directed toward satisfying the need to tailor airfoil characteristics specifically for HAWT's. The design criteria and the current status of this effort are presented.

6733 **Wind turbine cluster model.** Chan, S.M.; Cresap, R.L.; Curtice, D.H. (Systems Control, Inc., 1801 Page Mill Road, Palo Alto, CA 94304). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Power Apparatus and Systems;* **PAS-103**: No. 7, 1692-1698(Jul 1984).

An aggregate model for a cluster of identical, horizontal-axis wind turbines with induction generators is presented in this paper. In a transient stability program, this aggregate model is capable of simulating the effects of: (1) wind turbulence and tower shadow, and (2) external network disturbances such as faults and line switching. An example illustrating the cluster model is given.

# 20 ELECTRIC POWER ENGINEERING

## 2001 Power Plants And Power Generation

*REFER ALSO TO CITATION(S) 2001006272, 6272, 6314, 6889, 6907, 6908, 7306*

6734 **(EPRI-CS/NP—3743) Symposium on state-of-the-art feedwater heater technology: proceedings.** Coit, R.L.; Bell, R.J. (eds.). (Electric Power Research Inst., Palo Alto, CA (USA); Heat Exchanger Systems, Inc., Boston, MA (USA)). Oct 1984. 463p. (CONF-8406224—). Research Reports Center, P.O. Box 50490 Palo Alto, CA 94303 $37.00. File Number TI85920123.

From Symposium on state of the art feedwater heater technology; Washington, DC, USA (5 Jun 1984).

Separate abstracts were prepared for 20 papers in this symposium proceedings. (LEW)

6735 **(PB—84-232552) Investigation of construction failure of reinforced concrete cooling tower at Willow Island, WV. Final report.** Lew, H.S.; Fattal, S.G.; Shaver, J.R.; Reinhold, T.A.; Hunt, B.J. (National Bureau of Standards, Washington, DC (USA). Center for Building Technology). Sep 1982. 159p. NTIS, PC A08/MF A01.

Sponsored in part by Occupational Safety and Health Administration, Washington, DC. Library of Congress catalog card No. 82-600602. Also available from Supt. of Docs as SN003-003-02436-8.

The collapse of the natural-draft hyperbolic concrete cooling tower unit no. 2 at the Pleasants Power Station at Willow Island, West Virginia, was investigated by the National Bureau of Standards. The investigation included on-site inspections, laboratory tests of construction assembly components and concrete specimens, and analytical studies. Based on the results of these field, laboratory, and analytical investigations, it was concluded that the most probable cause of the collapse was due to the imposition of construction loads on the shell before the concrete of lift 28 had gained adequate strength to support these loads.

6736 **Method for minimizing contaminant particle effects in gas-insulated electrical apparatus.** Pace, M.O.; Adcock, J.L.; Christophorou, L.G. (to Dept. of Energy). US Patent 4,464,417. 7 Aug 1984. Filed date 2 Feb 1983. vp. PAT-APPL-463208.

Electrical breakdown of a gas insulator in high voltage apparatus is prevented by placing an electrical insulative coating on contaminant particles in the gas insulator.

6737 **Observations of erosion of in-bed tubes in the Great Lakes AFBC.** *Materials and Components in Fossil Energy Applications;* No. 46, 6-7(1 Oct 1983).

Initially, the atmospheric fluidized-bed combustor demonstration plant experienced erosion difficulties with low bed temperature, high heat transfer rates, low combustion efficiencies and high elutriation rates. Some of the blame for these problems was attributed to the bed particle size being finer than originally intended. The vertical surfaces exhibited high wear rates, and several of the tubes were polished with visible signs of wear. These high erosion rates were attributed to the tendency of bubbles rising through the bed to follow preferred paths along the vertical tube surface. One approach being considered to combat this problem is the use of fins transverse to the tube axis to disrupt the bubble flow pattern.

## 2002 Environmental Aspects

*REFER ALSO TO CITATION(S) 2002006312, 6313, 6315, 6316, 6318, 6325*

6738 **(EPRI-CS—3709) Operation and design of FGD dampers.** Smith, E.O.; Cannell, A.L.; Ferguson, A.W. (Black and Veatch, Kansas City, MO (USA)). Nov 1984. 269p. Research Reports Center, Box 50490, Palo Alto, CA 94303 $22.00. File Number TI85920144.

Flue gas desulfurization (FGD) system dampers are components that contribute to nonavailability to an extent disproportionate to other FGD components. Determining reasons for damper problems experienced in FGD service and formulating guidelines to alleviate these problems in future FGD installations are the overall objectives of this project. Utilities with operational FGD systems were surveyed to determine types of dampers being used in FGD applications and operating experience observed in service. From the survey information, eight plants were selected for in-depth field inspection and investigation of operating experience. Damper equipment suppliers were also surveyed to benefit from their experience in designing and troubleshooting damper equipment in FGD service. Interim results of the utility and supplier surveys are presented in this report. Results of field investigations of selected installations are also presented, and major problem areas and significant successes are identified. The primary objective of this interim report is to

disseminate, as soon as possible, the survey information gathered to date. The final report will provide further interpretation of this information and present guidelines for damper selection, specification, and evaluation.

6739 **(EPRI-CS—3710) Laboratory evaluation of modifications to the RESOX process. Final report.** Gutterman, C.; Steiner, P. (Foster Wheeler Development Corp., Livingston, NJ (USA)). Nov 1984. 167p. Research Reports Center, P.O. Box 50490, Palo Alto CA 94303 $17.50. File Number TI85920131.

The coupling of the Wellman-Lord (W-L) $SO_2$ concentrator process with Foster Wheeler Development Corporation's (FWDC) coal-based reduction process for converting $SO_2$ to elemental sulfur (RESOX) offers an attractive option when considering an integrated, regenerable flue gas desulfurization (FGD) system. FWDC investigated W-L/RESOX in its 1-MW RESOX pilot plant, utilizing both an anthracite and a caking bituminous coal with synthesized W-L gas compositions. A process modification, coal recycle, provided a high degree of carbon utilization (80%) and allowed the use of a caking bituminous coal which otherwise would not have been suitable. The program goal was to accumulate approximately 70 hours of operation with each coal. This was realized for the anthracite coal, but fell short when testing the bituminous coal. The bituminous program represented an initial effort toward utilizing a caking coal and, as such, was successful. Sulfur yields between 80 and 85% of the quantity available from the feedstock were realized with both coals for a small portion of the hours logged. The average yields were 74.0 and 70.5% for the anthracite and bituminous coals respectively. The program demonstrated that some caking bituminous coals may now be added to the list of reductants available for use with the RESOX process.

6740 (INIS-mf—9071, pp 58) **Track detector technique to measure the effective radium content and emanation factor of fly ashes at power plants.** Hunyadi, I.; Somogyi, G. (Magyar Tudomanyos Akademia, Debrecen. Atommag Kutato Intezete). 1984. (In Hungarian). NTIS (US Sales Only), PC A04/MF A01. File Number TI85780132. (CONF-8404195—Summ.).

From Training course on radiation protection; Balatonkenese, Hungary (11 Apr 1984).

6741 **(TVA/OP/EDT—82/20) Economic evaluation of advanced limestone, Davy S-H, and Dowa Gypsum-producing FGD processes.** Dotson, R.L.; Maxwell, J.D.; Burnett, T.A. (Tennessee Valley Authority, Chattanooga (USA). Div. of Energy Demonstrations and Technology). Feb 1984. 200p. (EPA—600/7-84-027). NTIS, PC A09/MF A01. File Number DE85900359.

Economic evaluations were made of three gypsum-producing FGD processes: advanced limestone (in-loop forced oxidation with adipic acid additive), Davy S-H (lime), and Dowa (aluminum sulfate, limestone). For a 500-MW power unit burning 3.5% sulfur coal and meeting the 1979 NSPS, capital investments in 1982 costs are 93 M$ (186 $/kW) for the advanced limestone process, 116 M$ (231 $/kW) for the Davy S-H process, and 121 M$ (243 $/kW) for the Dowa process. First-year annual revenue requirements in 1984 costs for these processes are 26, 33, and 32 M$ (9.4, 11.9, and 11.7 mills/kWh), respectively. The lower capital investment and annual revenue requirements of the advanced limestone process is due in part to the use of adipic acid, which allows partial scrubbing at 95% removal. The Davy S-H has slightly higher annual revenue requirements than the Dowa process because lime rather than limestone is used. Changes in power unit size and coal sulfur content affect the costs of all three processes similarly. The Davy S-H process is more sensitive to raw material costs because lime is used. Landfill waste disposal is a minor cost element in all three processes. 103 references, 26 figures, 30 tables.

## 2003 Power Transmission And Distribution

*REFER ALSO TO CITATION(S) 2003006463, 6710, 6713, 6892*

6742 **Voltage and current measurements on high power self-magnetically insulated vacuum transmission lines.** Maenchen, J.; Sheldon, H.T.; Rondeau, G.D.; Greenly, J.B.; Hammer, D.A. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Review of Scientific Instruments;* **55**: No. 12, 1931-1940(Dec 1984).

Experimental corroboration of a variety of distinct measurement techniques for determining the voltage and current constituents at a vacuum diode termination of a high power (500 GW) vacuum transmission line operating in a self-magnetic-insulation regime is presented. The inherent difficulties of measuring driver and load parameters with electric field strengths in excess of $10^6$ V/cm and vacuum electron flows comparable with the cathode conduction current have in the past been addressed by single nonverified measurement methods. In this work we perform multiple measurements and find agreement between B-dot and self-integrating Rogowski coil current diagnostics and consistency among the following voltage measurements: an equilibrium flow model calculation based on current flows, a time-resolved Thomson parabola, a resistive voltage monitor, a time-integrating Thomson parabola, and a Rutherford scattering time-of-flight system.

6743 **Cleaning process for corrugated aluminum electrical transmission line enclosure.** Bowman, G.K. (to Dept. of Energy). US Patent 4,461,126. 24 Jul 1984. Filed date 30 Mar 1982. vp.

PAT-APPL-363756.

A process for preparing the interior of a corrugated pipe or sheath comprises the steps of placing a predetermined amount of a tumbling abrasive material into the sheath, and then rotating the sheath.

6744 **Single transmission line data acquisition system.** Fasching, G.E. (to Dept. of Energy). US Patent 4,451,826. 29 May 1984. Filed date 18 Sep 1981. vp.

PAT-APPL-303674.

A single transmission line interrogated multiple channel data acquisition system is provided in which a plurality of remote station/sensors monitor specific process variables and transmit measurement values over the single transmission line to a master station when addressed by the master station. Power for all remote stations (up to 980) is provided by driving the line with constant voltage supplied from the master station and automatically maintained independent of the number of remote stations directly connected to the line. The transmission line can be an RG-62 coaxial cable with lengths up to about 10,000 feet with branches up to 500 feet. The remote stations can be attached randomly along the line. The remote stations can be scanned at rates up to 980 channels/second.

6745 **Particle trap to sheath non-binding contact for a gas-insulated transmission line having a corrugated outer conductor.** Fischer, W.H. (to Dept. of Energy). US Patent 4,444,993. 24 Apr 1984. Filed date 4 Nov 1982. vp.

PAT-APPL-439245.

A non-binding particle trap to outer sheath contact for use in gas insulated transmission lines having a corrugated outer conductor. The non-binding feature of the contact according to the teachings of the invention is accomplished by having a lever arm rotatably attached to a particle trap by a pivot support axis disposed parallel to the direction of travel of the inner conductor/insulator/particle trap assembly.

6746 **Toxicity of sparked $SF_6$.** Griffin, G.D.; Sauers, I.; Christophorou, L.G.; Easterly, C.E.; Walsh, P.J. (Oak Ridge National Lab., TN). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Electrical Insulation;* **EI-18**: No. 5, 551-552(Oct 1983).

A recent effort to study the biological activity of sparked $SF_6$ and the individual by-products of $SF_6$ is discussed. These studies were performed using in vitro cell culture techniques in a simple and rapid assay for cytotoxic effort. Hamster long cells were ex-

posed in vitro to gases in small tubes, and the biological activity of the gas was monitored by the resulting cellular death (cytoxicity) as assayed in a reproductive cell survival assay. The studies demonstrated that sparked $SF_6$ is toxic and the need for further systematic studies which couple physiochemical investigations of sparked $SF_6$ and toxicological testing, is indicated.

# 21 NUCLEAR POWER PLANTS

6747 **(IHZ-WK—81-380) Conference reports of session II.** (Ingenieurhochschule Zittau (German Democratic Republic)). 1982. 176p. (In German). (CONF-8205180—Pt.2). NTIS (US Sales Only), PC A09/MF A01. File Number DE85780209.

From 6. scientific conference on power economy; Zittau, German D.R. (11 May 1982).

Separate abstracts are presented for each of the papers included in the data base.

6748 **Nuclear power: the next generation.** Besmann, T.M. (Oak Ridge National Lab., TN). *High Technology;* **4**: No. 11, 12-13(Nov 1984).

There is a growing consensus within the nuclear power industry that reactors will have to be simpler, less costly, and safe beyond a doubt if they are to become attractive again. The major vendors are pursuing new, more efficient, and highly standardized reactor designs that are variants of present-day reactors built to meet the strict safety standards in an economical way. Others are taking another look at gas-cooled reactors that would take longer to reach fuel-damaging temperatures in the event of coolant loss. Work on the Integral Fast Reactor based on liquid metal will take advantage of the compactness, high operating efficiency, safety, and the ability to produce substantial fuel from nonfuel uranium. Despite the cost effectiveness of large reactors, smaller and modular reactors may meet utility needs better. Financing is the greatest problem because of the long lead time and regulatory uncertainties.

## 2101 Power Reactors, Non-breeding, Light-water Moderated, Boiling Water Cooled

*REFER ALSO TO CITATION(S) 2101006460, 6786, 6802, 6815, 6816, 6823, 6824, 6828, 6830, 6832, 6836, 6839, 6843, 6860, 6861, 6865, 6866, 6868, 6877, 6880*

6749 **(NUREG/CR—3052) Closeout of IE Bulletin 80-07: BWR jet pump assembly failure.** Dean, R.S.; Mills, W.R.; Foley, W.J.; Hennick, A. (Parameter, Inc., Elm Grove, WI (USA)). Nov 1984. 57p. NTIS, PC A04/MF A01 - GPO* $4.50. File Number TI85900344.

In February 1980, disassembly of a jet pump at Dresden 3 was diagnosed from changes in operating parameters. After prompt shutdown, it was found that a broken hold-down beam had caused the failure and that six other beams had small cracks. In March 1980, one cracked beam at Quad Cities 2 and three at Pilgrim 1 were discovered, and an earlier pump failure at a foreign facility was found to be like that at Dresden 3. IE Bulletin 80-07 was issued April 4, 1980 to licensees of all General Electric BWR/3 and BWR/4 operating facilities to require daily operability surveillance of jet pumps and nondestructive examinations every refueling outage. The bulletin was issued for information to holders of construction permits for General Electric facilities; later, 13 of these facilities were selected for written responses. Extensive studies led to the conclusion that failures were caused by very slowly progressing stress corrosion cracking, and resulted in manufacture of improved beams. Bulletin status is determined by applying closeout criteria. Closeout of bulletin Item B.2 requiring operability surveillance is based on the short-term action of implementing an acceptable method and the long-term action of continuing that method until satisfactory corrective action has been completed. Followup items are suggested for all 20 operating facilities to ensure compliance with bulletin requirements and intent. The safety significance of a jet pump failure is that flow distribution would be affected during normal operation and the water level in the core region would decrease during a coincidental loss of cooling accident.

6750 **(PB—84-224856) Requirements for referencing reactor pressure vessel surveillance dosimetry to benchmark neutron fields. Final report.** McGarry, E.D. (National Bureau of Standards, Washington, DC (USA)). 1982. 20p. Pub. in Proceedings of International Atomic Energy Agency Meeting, Vienna, Austria, Oct 12-16, 1981, p29-45, 1982.

The objective of benchmark field referencing is to guarantee measurement accuracy of dosimetry methods for LWR-PV Dosimetry Surveillance by carrying out various types of calibration irradiations in well-characterized neutron fields. The participation of the National Bureau of Standards in particular phases of benchmarking is discussed and the status of activities is given. Notable applications to date are given.

6751 **(TID—27512) Inside versus outside reinforcing of nozzles in spherical shells with pressure loading.** Rodabaugh, E.C.; Gwaltney, R.C. (Battelle Columbus Labs., OH (USA)). Jan 1974. Contract AC05-84OR21400. 54p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85000040.

Phase report No. 117-7.

This report presents the results of calculated stresses of nozzles and manholes in spherical shells covering a relatively wide range of parameters. Based on these calculations, it is concluded that the stress indices for nozzles in spherical shells may not be conservative where all of the reinforcing is placed on the inside. Recommendations for code changes are given.

6752 **Inconel-618E: An alloy developed for high-temperature gas-cooled reactor service.** Ligenfelter, A.C. (Lawrence Livermore National Laboratory, Livermore, California 94550). *Nuclear Technology;* **66**: No. 1, 63-68(Jul 1984).

Inconel-618E (54 Ni-23 Cr-6 W) was developed specifically to meet the requirements of the high-temperature gas-cooled reactor (HTGR). The alloy has good fabricability, weldability, and, above all, metallurgical stability. Alloy 618E is free of cobalt and aluminum. At temperatures of 954°C (1750°F) and higher, alloy 618E has stress rupture strength comparable to Inconel-617. At lower temperatures, the rupture strength of alloy 618E is somewhat lower than that of alloy 617. Alloy 617 remains the best-established alloy for HTGR service. However, alloy 618E does not have that material's disadvantage of aluminum and cobalt content and may become a candidate for HTGR applications.

## 2102 Power Reactors, Non-breeding, Light-water Moderated, Non-boiling Water Cooled

*REFER ALSO TO CITATION(S) 2102006455, 6456, 6457, 6460, 6750, 6751, 6778, 6786, 6797, 6798, 6799, 6800, 6802, 6808, 6811, 6812, 6813, 6816, 6818, 6820, 6823, 6825, 6826, 6827, 6829, 6832, 6834, 6835, 6836, 6838, 6839, 6844, 6845, 6846, 6849, 6850, 6853, 6859, 6864, 6865, 6866, 6868, 6869, 6870, 6871, 6877, 6879, 6880, 6887, 7381, 7415*

6753 **(DOE/ET/34212—45) Development of an advanced extended-burnup fuel assembly design incorporating uranium-gadolinia. Fifth semi-annual progress report, April-September 1983.** Newman, L.W.; Thornton, T.A.; Rodes, J.R.; Mason, F.L.; Holman, P.L.; Pyecha, T.D.; McInteer, W.A.; Bain, G.M.; Papazoglou, T.P.; Campbell, P.S. (Babcock and Wilcox Co., Lynchburg, VA (USA); Duke Power Co., Charlotte, NC (USA)). Oct 1984. Contract AC02-78ET34212. 105p. (BAW—1681-5). NTIS (US Sales Only), PC A06/MF A01; 1; GPO Dep. File Number DE85004347.

During this period, the following activities were completed: the irradiation of a standard Mark B assembly for a fifth cycle, the fabrication and characterization of five lead test assemblies containing $UO_2$-$Gd_2O_3$ in selected rods, and the fabrication and installation of an intercalibrated movable incore detector system at Oconee Unit 1. Activities that either began or continued during this period include nondestructively examining the fifth-cycle assembly at poolside, irradiating the LTAs for their first cycle, and compiling cladding waterside oxide thickness data on standard Mark B fuel rods.

6754 **(EGG-M—23884) Diagnostic instrumentation for detection of the onset of steam tube leaks in PWRs.** Roach, W.H. (Idaho National Engineering Lab., Idaho Falls (USA)). 1984. Contract AC07-76ID01570. 20p. (CONF-8410142—43). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003413.

From 12. water reactor safety research information meeting; Gaithersburg, MD, USA (23 Oct 1984).

Four tasks are addressed in this study of the detection of steam tube leaks: determination of which physical parameters indicate the onset of steam generator tube leaks; establishing performance goals for diagnostic instruments which could be used for early detection of steam generator tube leaks; defining the diagnostic instrumentation and their location which satisfy Items 1 and 2; and assessing the need for diagnostic data processing and display. Parameters are identified, performance goals established and sensor types and locations are specified in the report, with emphasis on the use of existing instrumentation with a minimum of retrofitting. A simple algorithm is developed which yields the leak rate as a function of known or measurable quantities. The conclusion is that leak rates of less than one-tenth gram per second should be detectable with existing instrumentation.

6755 **(HEDL-SA—3063A) Characterization of fuel distributions in the Three-Mile Island Unit 2 (TMI-2) reactor system by neutron and gamma-ray dosimetry.** Gold, R.; Roberts, J.H.; Ruddy, F.H.; Preston, C.C.; McNeece, J.P.; Kaiser, B.J.; McElroy, W.N. (Hanford Engineering Development Lab., Richland, WA (USA)). Apr 1984. Contract AC06-76FF02170. 5p. (CONF-840902—13). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85000292.

From 5. ASTM-Euratom symposium on reactor dosimetry; Geesthacht, F.R. Germany (24 Sep 1984).

The resolution of technical issues generated by the accident at Three-Mile Island Unit 2 (TMI-2) will inevitably be of long range benefit. Determination of the fuel debris dispersal in the TMI-2 reactor system represents a major technical issue. In reactor recovery operations, such as for the safe handling and final disposal of TMI-2 waste, quantitative fuel assessments are being conducted throughout the reactor core and primary coolant system.

6756 (INIS-mf—9071, pp 21) **Studies of the cable lead throughs across the shieldings at the PAKS Nuclear Power Plant.** Horvath, E.; Ronaky, J. (Paksi Atomeroemue Vallalat (Hungary)); Viragh, E. (Budapesti Mueszaki Egyetem (Hungary). Egyetemi Reaktor). 1984. (In Hungarian). NTIS (US Sales Only), PC A04/MF A01. File Number TI85780132. (CONF-8404195—Summ.).

From Training course on radiation protection; Balatonkenese, Hungary (11 Apr 1984).

6757 **(INIS-mf—9157) Kernkraftwerk Sued - the Wyhl decision of March 30, 1982/July 6, 1982.** (Verwaltungsgerichtshof Baden-Wuerttemberg, Mannheim (Germany, F.R.). Pressestelle). 1982. 567p. (In German). NTIS (US Sales Only), PC A24/MF A01. File Number DE85780151.

This volume contains the complete Wyhl decision of the Higher Administrative Court of Baden-Wuerttemberg of March 30, 1982-X575/77, X578/77, X583/77 which covers 548 pages. According to the press release the complete decision has been delivered to the counsels of the parties to the lawsuit on July 7, 1983; on the appeal of the defendant Land and the attending Kernkraftwerk Sued GmbH the Higher Administrative Court has amended the decisions of the Administrative Court of Freiburg of March 14, 1977 and has rejected the actions of nine citizens against the first part construction permit. Moreover, the senate has sent to the parties to the lawsuit the decision of March 30, 1982, by which the value in dispute for these proceedings on appeal is fixed to DM 180,000. The time for the lodging of an appeal, which has been admitted by the senate in this process, begins with the delivery of the completely well-founded decision. Moreover, the volume contains a 10 pages summary of contents of the decision and a table of contents of the reasons for the decision.

6758 **(NUREG—1102-App.A) Technical specifications Diablo Canyon Nuclear Power Plant, Unit No. 1 (Docket No. 50-275). Appendix A to License No. DPR-80.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Nov 1984. 465p. NTIS, PC A20/MF A01 - GPO* $9.50. File Number TI85900339.

This Appendix includes definitions, safety limits and limiting safety system settings, limiting conditions for opertion and surveillance requirements, bases, design features, and administrative controls. (DLC)

6759 **(NUREG/CR—3728) Effect of temperature on the stress-relaxation response of a pressure vessel steel.** Goodwin, G.M.; Nanstad, R.K. (Oak Ridge National Lab., TN (USA)). Oct 1984. Contract AC05-84OR21400. 19p. (ORNL/TM—9149). NTIS, PC A02/MF A01 - GPO. File Number TI85003588.

Extensive cracking in the steam generator shells at Indian Point Station Unit 3 led to questions as to the effectiveness of the postweld heat treatment (PWHT) used during fabrication. A literature review revealed an absence of stress-relaxation data for the steels of interest, SA-302, grade B, and SA-533, grade B. This investigation was undertaken to characterize the stress-relaxation response at various PWHT temperatures and to determine the correlation, if any, with other measurable properties, such as hardness. A novel technique utilizing a closed-loop thermal-mechanical simulator, the Gleeble 1500, was developed and used. After producing a microstructure typical of a portion of the heat-affected zone (HAZ) of a weldment, we tested stress relaxation at eight temperatures, 482, 510, 538, 566, 593, 621, 649, and 677°C (900, 950, 1000, 1050, 1100, 1150, 1200, and 1250°F). We determined that 20 min (1200 s) was an adequate test time and that the magnitude of stress measured agreed with limited literature data for comparable materials. Substantial stress relaxation was noted at 593°C (1100°F) and above. Post-test hardness correlated very well with relaxation data.

6760 **(PNL-SA—12531) Results of research utilizing a retired from service PWR steam generator.** Clark, R.A. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1984. Contract AC06-76RL01830. 14p. (CONF-841093—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003108.

From Specialist meeting on steam generator problems; Stockholm, Sweden (1 Oct 1984).

After less than six years operation the Surry 2 generators were replaced. A combination of design short comings and poor operating practice led to this early failure. This research program has documented massive structural deformation of the secondary side, which of itself could potentially compromise the primary system boundary. No major unexpected defect types have been found, with the exception of subsequent deformation and bursting of plugged tubes. Preliminary evaluation of eddy current post-service baseline and round robin test data indicate some discrepancies in detection of indications. However, there were considerable team-to-team variations in analysis of indications, defect versus deposit, and in defect sizing.

6761 **Uranium recovery from a nuclear fuel.** Miller, R.L.; Flinn, J.E.; Welch, J.M. (EG & G Idaho, Inc., Idaho Falls, Idaho). *Preprint, Society of Mining Engineers of AIME;* **84-162**: 13(Feb 1984). (CONF-840218—).

From 113. annual meeting of the American Institute of Mining, Metallurgical and Petroleum Engineers; Los Angeles, CA, USA (26 Feb 1984).

Two samples of iron enriched basalt (IEB) containing simulated nuclear fuel and having two distinct microstructures were prepared and tested for uranium recovery. The IEBs are refractory towards leaching by ground water. However, the uranium content (15.8%) is high enough that if aggressive leaching techniques are used for uranium recovery, these materials could be considered as man-made uranium ores. The IEBs discussed in this report were prepared to simulate Three Mile Island-2 core debris. The crushed IEBs were treated using three different methods simulating potential industrial scale processes. In one method the IEBs were fused with sodium hydroxide then the cooled mass leached first with

water then with dilute sulfuric acid; about 52% of the uranium was recovered in this case. In the second method the IEBs were treated with a sulfuric acid/hydrogen peroxide lixiviant and about 13% of the uranium was recovered. In the third technique the IEBs were leached with a sodium carbonate/sodium bicarbonate/hydrogen peroxide solution. Only about 0.1% of the uranium was recovered. The results of these screening tests suggest that the IEBs can be successfully treated for recovery of the contained uranium. Other studies would be required to determine if other values, such as zirconium or silver, could be recovered from the IEBs.

## 2103 Power Reactors, Non-breeding, Graphite Moderated

*REFER ALSO TO CITATION(S) 2103006447, 6448, 6814, 6837, 6842, 7261*

6762 **(DP-Report—1000) Summary and evaluation of the achievements of the Dragon Project and its contribution to the development of the high temperature reactor.** Howard, R.M.; Price, S.T.; Shepherd, L.R. (eds.). (UKAEA Atomic Energy Establishment, Winfrith). Nov 1978. 671p. NTIS (US Sales Only), PC A99/MF A01. File Number DE85900217.

DPR 1000 is a complete account of the development of a new nuclear reactor system from its conception; covering the establishing of the technology; the design and construction of a small demonstration reactor and its eventual operation. The high temperature helium cooled reactor concept, originating in the Atomic Energy Research Establishment at Harwell, was adopted as the basis for the Dragon Project, a collaborative venture of twelve European countries set up under the aegis of the OECD (then OEEC).

6763 **(Juel—1902) Installation of a programme system for determination of HEU/LEU-equilibrium-combined cores for pebble bed reactors and applicaton to the AVR-reactor.** Kuh, J.E. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorentwicklung; Technische Hochschule Aachen (Germany, F.R.)). Mar 1984. 165p. (In German). NTIS (US Sales Only), PC A08/MF A01. File Number DE84752330.

In this work different HEU/LEU-equilibrium-combined core configurations were calculated. By analysis of these results the optimum operation strategy and the accompanying equilibrium core are determined and the essential influence quantities on temperature profiles and shut-down balance are worked out: 1) The neutron-physical and thermodynamic properties of the combined core are adjustable in broad limits by changing the operating conditions of fuelling. 2) The shut-down balance is strongly dependent on the part of LEU-fuel elements; it is running short with increasing LEU-part among other things because of the comparatively higher absorption in the core. 3) The thermodynamic behaviour is getting more favourable with increasing LEU-part. 4) The influence of the eliminating age of the HEU-fuel elements on the neutron physical and thermodynamic behaviour is much more stronger than that of the LEU-elements. 5) The temperature profiles of the core become much more favourable with increasing elimination age of the LEU-fuel elements and with decreasing elimination age of the HEU-fuel elements.

6764 **Hastelloy-X for high-temperature gas-cooled reactor applications.** McCoy, H.E.; King, J.F.; Strizak, J.P. (Oak Ridge National Laboratory, P.O. Box X, Oak Ridge, Tennessee 37831). *Nuclear Technology;* **66**: No. 1, 161-174(Jul 1984).

Hastelloy-X is a potential structural material for use in gas-cooled reactor systems. In this application, data are necessary on the mechanical properties of base metal and weldments under realistic service conditions. The test environment studied was helium that contained small amounts of $H_2$, $CH_4$, and CO. This environment was found to be carburizing, with the kinetics of this process becoming rapid above 800°C. Suitable weldments of Hastelloy-X were prepared by several processes; those weldments generally had the same properties as base metal except for lower fracture strains under some conditions. Some samples were aged for up to 20 000 h in the test gas and tested, and some creep tests on as-received material exceeded 40 000 h. The predominant effects of aging were the significant reduction in the fracture strains at ambient temperature and the lower strains for samples aged in high-temperature gas-cooled reactor (HTGR) helium than for those aged in inert gas. Under some conditions, aging also resulted in increased yield and ultimate tensile strength. Creep tests failed to show the effects of environment, aging, or welding on the creep strength of Hastelloy-X; however, the fracture strains for weldments were generally lower than they were for base metal. Prior aging in inert gas for 20 000 h at 538 and 871°C reduced the fatigue life slightly, but no difference was observed in the fatigue properties of samples aged in air and HTGR helium environments.

6765 **(ORNL-tr—5161) Diffusion kinetics according to the trap model with the third boundary condition.** Gaus, H. Translated from *Journal of Nuclear Materials ;* No. 92, 243-248(1980). Contract AC05-84OR21400. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85000627. DE85000627

The diffusion of activated fission products in graphite and corresponding measurements of cesium transport are considered. Solutions of the diffusion equation with constant absorption- and reemission-coefficient were evaluated. As boundary condition the flux through the surface of the specimen was assumed to be proportional to the difference concentration on the surface minus a fixed given concentration, which condition corresponds to an evaporation. In particular the Fourier sums for cylinder, sphere and rectangular parallelepiped are determined and discussed especially with respect to neglect of reemission for small times and on asymptotic behavior for large times. As initial condition there is assumed uniform distribution and thin layer concentration for one dimensional space dependence.

## 2104 Power Reactors, Non-breeding, Otherwise Moderated Or Unmoderated

*REFER ALSO TO CITATION(S) 2104006812, 6847*

6766 **Apparatus for monitoring tritium in tritium contaminating environments using a modified Kanne chamber.** Anderson, D.F. (to Dept. of Energy). US Patent 4,445,037. 24 Apr 1984. Filed date 27 Jan 1981. vp.

PAT-APPL-229024.

A conventional Kanne tritium monitor has been redesigned to reduce its sensitivity to such contaminants as tritiated water vapor and tritiated oil. The high voltage electrode has been replaced by a wire cylinder and the collector electrode has been reduced in diameter. The area sensitive to contamination has thereby been reduced by about a factor of forty while the overall apparatus sensitivity and operation has not been affected. The design allows for in situ decontamination of the chambers, if necessary.

## 2105 Power Reactors, Breeding

*REFER ALSO TO CITATION(S) 2105006447, 6448, 6796, 6819, 6872, 6881*

6767 **(AEEW-R—1715) Comparison of measured neutron reaction rates in fast reactor steels with calculated values using FD5 data.** Murphy, M.F.; Stevenson, J.M.; Taylor, W.H. (UKAEA Atomic Energy Establishment, Winfrith). Jun 1984. 56p. NTIS (US Sales Only), PC A04/MF A01. File Number DE85900414.

Measurements have been made in three Zebra assemblies of the γ-activity of typical fast power reactor steel components. As a result of corrosion, these become important contributors to the activity of the primary coolant circuit during shut-down. Reaction rates were determined by dissolving irradiated samples and presenting them to a calibrated Ge-Li spectrometer and were expressed relative to Pu239 fission rates in positions near the samples. Calculated values for the reaction-rate ratios have been obtained using fluxes from standard Zebra calculations together with the activation cross-sections recommended for power reactor use. The measured and calculated reactor-rate ratios are compared for all the activities,

and bias factors wtih uncertainties of less than 10% produced for the more important contributions to the steel activation. Calculated spectra in the 37-group FD5 structure are presented to allow any new activation cross-section data to be tested against the measured reaction rates.

6768 **(CONF-840901—21) Physics implications of oxide and metal fuel on the design of small LMFBR cores.** Orechwa, Y.; Khalil, H. (Argonne National Lab., IL (USA)). 17 Sep 1984. Contract W-31-109-ENG-38. 13p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85002743.

From ANS topical meeting on reactor physics and shielding; Chicago, IL, USA (17 Sep 1984).

Slower growth projections in the demand for electricity and advances in metal fuel technology have shifted some of the emphasis in fast reactor development in the US from large oxide cores to small cores and also renewed interest in metal fuel. Cores constrained by diameter and fuel burnup exhibit many similar neutronic performance characteristics. However, some parameters such as reactivity coefficients, for example, are very different. The physics parameters of the four cores studied suggest that metal fueled cores, although less developed than oxide cores, are more flexible in adapting to currently changing deployment scenarios.

6769 **(KFK—3632) Kinetics of the oxygen transport in the fuel pin of a fast breeder reactor.** Lin, L.F. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Neutronenphysik und Reaktortechnik; Karlsruhe Univ. (T.H.) (Germany, F.R.). Fakultaet fuer Maschinenbau). May 1984. 100p. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE84752328.

The radial and axial transport of oxygen in the fuel pin of a fast breeder reactor has been described by a kinetic model. Oxygen is transported in fast reactor fuel pin among temperature gradients which changes the initially uniform distribution of oxygen. So far only the radial transport and only the stationary state has been described in models. However, for the description of the transient behaviour and of the axial oxygen transport a two-dimensional kinetic model is needed. The presented model combines for the first time the two transport mechanism of oxygen transport, namely thermal diffusion in the solid bulk and gaseous by $CO/CO_2$ and $H_2/H_2O$ mixtures in the available free volumes. The transport quantities needed for the description of the gaseous migration have been measured in gas permeation experiments on sintered $UO_2$ samples of different densities. Finally the oxygen/metalratio of an unirradiated (Usub(0.8)Pusub(0.2))Osub(1.96) - fuel has been calculated in radial and axial direction as a function of time. The results allow for the first time to draw conclusions about the relative importance of both oxygen transport mechanism as a function of time.

6770 **(NUREG/CR—3910) Dynamic simulation of the air-cooled decay heat removal system of the German KNK-II experimental breeder reactor.** Schubert, B.K. (Brookhaven National Lab., Upton, NY (USA)). Jul 1984. Contract AC02-76CH00016. 54p. (BNL-NUREG—51806). NTIS, PC A04/MF A01 - GPO. File Number TI85003163.

A Dump Heat Exchanger and associated feedback control system models for decay heat removal in the German KNK-II experimental fast breeder reactor are presented. The purpose of the controller is to minimize temperature variations in the circuits and, hence, to prevent thermal shocks in the structures. The basic models for the DHX include the sodium-air thermodynamics and hydraulics, as well as a control system. Valve control models for the primary and intermediate sodium flow regulation during post shutdown conditions are also presented. These models have been interfaced with the SSC-L code. Typical results of sample transients are discussed.

6771 **Overflow control valve.** Hundal, R.; Kessinger, B.A.; Parlak, E.A. (to Dept. of Energy). US Patent 4,461,317. 24 Jul 1984. Filed date 6 Apr 1981. vp.

PAT-APPL-251647.

An overflow control valve for use in a liquid sodium coolant pump tank which valve can be extended to create a seal with the pump tank wall or retracted to break the seal thereby accommodating valve removal. An actuating shaft which controls valve disc position also has cams which bear on roller surfaces to force retraction of a sliding cylinder against spring tension to retract the cyclinder from sealing contact with the pump tank.

6772 **Recent developments in the small-sample reactivity discrepancy.** Smith, K.S.; Schaefer, R.W. (Argonne National Laboratory). *Nuclear Science and Engineering;* **87**: No. 3, 314-332(Jul 1984).

Results of recent fissile small sample worth experiments in three fast reactor diagnostic critical assemblies are presented. These experiments produced significant insight into heterogeneityrelated errors in standard calculational models of worth experiments in plate-type critical assemblies. Results of improved techniques for calculation of worth experiments are presented, and the mean ratios of calculated to experimental worths in the three new benchmark critical assemblies are shown to be in the range from 0.97 to 1.04. The implications of the improved understanding of small sample worth experiments with respect to previously reported critical experiments are discussed.

6773 **Experimental studies of radially heterogeneous liquid metal fast breeder reactor critical assemblies at the zero-power plutonium reactor.** McFarlane, H.F.; Brumbach, S.B.; Carpenter, S.G.; Collins, P.J.; Olsen, D.N. (Argonne National Lab., Idaho Falls, US). *Nuclear Science and Engineering;* **87**: No. 3, 204-232(Jul 1984).

Experimental programs to investigate the physics characteristics of heterogeneous liquid metal fast breeder reactor cores have been conducted in the zero-power plutonium reactor critical facility over a period of about5 yr. Previous experiments on conventional homogeneous cores provided appropriate benchmark data against which to judge the heterogeneous core results. For a heterogeneous reactor of the Clinch River Breeder Reactor size, both the physics parameters and the ability to predict them by common design methods differ substantially from an equivalent conventional design. Data errors and methods approximations have a greater effect in the analysis of heterogeneous cores, particularly with respect to such spatially varying parameters as power distributions and control rod worths. Preliminary results from recent experiments on a 700-MW (electric)-sized heterogeneous assembly are presented. As expected, predictions of physics parameters in general are worse than for conventional cores. Eigenvalue spectra and cross-section sensitivity have been used to characterize the spatial sensitivity of the cores.

## 2106 Power Reactors, Auxiliary, Mobile, Package, And Transportable

*REFER ALSO TO CITATION(S) 2106006806, 6878*

6774 **(LA-UR—84-3388) Opening up the future in space with nuclear power.** Buden, D.; Angelo, J. Jr. (Los Alamos National Lab., NM (USA); Florida Inst. of Tech., Melbourne (USA)). 1985. Contract W-7405-ENG-36. 22p. (CONF-850103—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE85002411.

From 2. symposium on space nuclear power systems; Albuquerque, NM, USA (14 Jan 1985).

Man's extraterrestrial development is dependent on abundant power. For example, space-based manufacturing facilities are projected to have a power demand of 300 kWe by the end of this Century, and several megawatts in the early part of next millennium. The development of the lunar resource base will result in power needs ranging from an initial 100 kW(e) to many megawatts. Human visits to Mars could be achieved using a multimegawatt nuclear electric propulsion system or high thrust nuclear rockets. Detailed exploration of the solar system will also be greatly enhanced by the availability of large nuclear electric propulsion systems. All of these activities will require substantial increases in space power - hundreds of kilowatts to many megawatts. The challenge is clear: how to effectively use nuclear energy to support humanity's expansion into space.

## 2107 Regulation And Licensing

*REFER ALSO TO CITATION(S) 2107006757, 6851, 6857*

6775 **(NUREG—0748-Vol.4-No.9) Operating reactors licensing actions summary. Volume 4, No. 9.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Resource Management). Nov 1984. 414p. NTIS, PC A18/MF A01 - GPO*. File Number TI85900361.

This document is designed to provide the management of the Nuclear Regulatory Commission (NRC) with an overview of licensing actions dealing with operating power and nonpower reactors. These reports utilize data collected from the division of licensing in the Office of Nuclear Reactor Regulation and are prepared by the Office of Resource Management.

6776 **(NUREG—0750-Vol.19) Indexes to Nuclear Regulatory Commission issuances, January-June 1984. Vol. 19, Index 2.** (Nuclear Regulatory Commission, Washington, DC (USA)). Nov 1984. 113p. NTIS, PC A06/MF A01 - GPO*. File Number TI85900437.

Digests and indexes for issuances of the Commission (CLI), the Atomic Safety and Licensing Appeal Panel (ALAB), the Atomic Safety and Licensing Board Panel (LBP), the Administrative Law Judge (ALJ), the Directors' Decisions (DD), and the Denials of Petitions of Rulemaking are presented in this document. The information elements are displayed in one or more of five separate formats: case name index, digests and headers, legal citations index, subject index, and facility index.

6777 **(NUREG—0750-Vol.20-No.1) Nuclear Regulatory Commission issuances. Volume 20, No. 1.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Technical Information and Document Control). Jul 1984. 253p. NTIS, PC A12/MF A01 - GPO*. File Number TI85900411.

This report includes the issuances received during July 1984 from the Commission (CLI), the Atomic Safety and Licensing Appeal Boards (ALAB), the Atomic Safety and Licensing Boards (LBP), the Administrative Law Judge (ALJ), the Director's Decisions (DD), and the Denials of Petitions for Rulemaking (DPRM). The summaries and headnotes preceding the opinions reported herein are not to be deemed a part of those opinions or to have any independent legal significance.

6778 **(NUREG—1058-Rev.1) Technical specifications: Callaway Plant, Unit No. 1 (Docket No. STN 50-483). Appendix A to License No. NPF-30. Revision 1.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Oct 1984. 493p. NTIS, PC A21/MF A01 - GPO* $9.50. File Number TI85900383.

Revised specifications are presented concerning limiting safety system settings for control systems, power distribution, instrumentation, coolant system, emergency core cooling system, containment systems, plant systems, electrical systems, refueling operations, radioactive effluents, and radiation environmental monitoring.

## 2108 Economics

*REFER ALSO TO CITATION(S) 2108006748*

6779 **(BMI—1984-042) Requirements for a reactor simulator of the konvoi generation of nuclear power plants according to training programs.** Reinartz, S.J.; Reinartz, G. (Bundesministerium des Innern, Bonn (Germany, F.R.); Technischer Ueberwachungs-Verein Rheinland e.V., Koeln (Germany, F.R.). Inst. fuer Unfallforschung). Jun 1984. 106p. (In German). NTIS (US Sales Only), PC A06/MF A01. File Number DE84752333.

This report is based an a review of the literature published on simulator training and on discussions with representatives from the German nuclear power plant operator training schools. A brief description of the organisation and content of the simulator training of control room operators in a number of countries, together with a categorisation of the various types of simulators which are used. The concepts of the systems approach to training and simulator fidelity are discussed. Some general training principles which are considered important for simulator training are summarised. From the available descriptions and analyses of control room operator tasks, the skills (in most general terms) which can be trained on simulators have been identified. Methods for training these skills which are used in the simulator training programmes in various industries and which have been developed in research work in the area of training psychology have been summarised. Using these methods as a basis, the necessary instructor facilities which should be included in the design of a full simulator for the Konvoi generation of nuclear power plants have been derived.

6780 **(BMI—1984-043) Framework of orientation for the discussion of measures required to maintain and further the expert knowledge and qualification of nuclear power plant managers and supervisors.** Farber, G. (Bundesministerium des Innern, Bonn (Germany, F.R.); Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). Jul 1984. 157p. (In German). (GRS-A—937). NTIS (US Sales Only), PC A08/MF A01. File Number DE84752340.

This report is focussed on the important aspects of the training and retraining of nuclear power plant managers and supervisors. The functional levels of the onsite operating organization of nine nuclear power plants are described and analyzed in order to determine the comparability of management positions as well as the responsibilities of the job incumbents. Retraining requirements are suggested depending on position, responsibilities, and relevance to safety. The manager's role in case of emergencies leads to specific demands with regard to regular training to cope with inadequate core cooling and to mitigate accidents.

6781 **(CONF-8410142—25) Maintenance personnel performance simulation (MAPPS) model: overview and evaluation efforts.** Knee, H.E.; Haas, P.M.; Siegel, A.I.; Bartter, W.D.; Wolf, J.J.; Ryan, T.G. (Oak Ridge National Lab., TN (USA); Applied Psychological Services, Inc., Wayne, PA (USA); Nuclear Regulatory Commission, Washington, DC (USA)). 1984. Contract AC05-84OR21400. 16p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85002320.

From 12. water reactor safety research information meeting; Gaithersburg, MD, USA (23 Oct 1984).

The development of the MAPPS model has been completed and the model is currently undergoing evaluation. These efforts are addressing a number of identified issues concerning practicality, acceptability, usefulness, and validity. Preliminary analysis of the evaluation data that has been collected indicates that MAPPS will provide comprehensive and reliable data for PRA purposes and for a number of other applications. The MAPPS computer simulation model provides the user with a sophisticated tool for gaining insights into tasks performed by NPP maintenance personnel. Its wide variety of input parameters and output data makes it extremely flexible for application to a number of diverse applications. With the demonstration of favorable model evaluation results, the MAPPS model will represent a valuable source of NPP maintainer reliability data and provide PRA studies with a source of data on maintainers that has previously not existed.

6782 **(DOE/EIA—0439(84)) Survey of nuclear power plant construction costs, 1984.** (USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels). Nov 1984. 71p. NTIS, PC A04/MF A01; 1 - GPO; GPO Dep. File Number DE85003598.

This report presents cost estimates, chronological data on construction progress, and the physical characteristics of nuclear units in construction as of March 31, 1984. Data on US nuclear power plants that were in commercial operation on March 31, 1984, are also presented. Three types of information are included: plant characteristics and ownership, construction costs, and construction schedule or chronology. Summary statistics are presented on estimated total costs, disbursed costs, capacity, average construction costs, and construction leadtimes for a sample of operating units and units in the construction pipeline. The reactor-specific cost data included in Chapter 5 are the estimated final nuclear pro-

duction plant costs and, for units in construction, the disbursed costs (funds already expended) and sunk costs (funds expended plus funds committed but not yet expended) as of March 31, 1984. As of March 31, 1983, 71 units were reported to be in construction. That total included 59 units actively under construction and 12 units which had been deferred but were still considered to be in the construction pipeline, since they had not been officially canceled. The status of those 71 units as of March 31, 1984, is summarized. Of the 59 units that were reported to be actively under construction as of March 31, 1983, 39 were still actively under construction on March 31, 1984; 10 were completed; 5 were canceled; and construction of 5 had been deferred. Of the 12 units reported as deferred last year, 3 were canceled, and the status of the other 9 was unchanged.

6783 **(GRS-A—634) Annual report 1980 concerning the examination and licensing of nuclear power plant shift personnel.** Knuefer, H.; Schulz, W. (Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). Aug 1984. 29p. (In German). Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.).

The licensing and supervising authorities responsible for the implementation of the nuclear energy law in the various Laender use the 'Guide for examination and licensing of nuclear power plant personnel' as a basis for examinations to give proof of appropriate expert knowledge. This guide has been amended by the Laender Committee for Nuclear Energy on May 17th, 1979. The guide demands among other things that shift supervisory, deputy supervisors and reactor operators pass a written and oral examination of their expert knowledge prior to their first mission. The report 'Examination and Licensing of Shift Personnel in Nuclear Power Plants from 1975 to 1984' was published for the past period of several years, as well as the annual report 1979, and the present report for 1980. Since 1979 the GRS have been presenting annual reports on the experience gained in the examinations of the preceding year. As the members of the examination committee have access to the documents concerning the written examination, the practical experience, and the special training of the candidates, this annual report covers also those aspects and not only the resutls of the oral examination.

6784 **(GRS-A—749) Annual report 1981 concerning the examination and licensing of nuclear power plant shift personnel.** Knuefer, H. (Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). Sep 1982. 44p. (In German). Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.).

In accordance with the extended scope of tasks, the present annual report is considerably more comprehensive than the two preceding reports and differs in the way of being arranged. For example, the 21 tables and pictures are given in a separate appendix. There are also modifications concerning details, as e.g. the bibliography, resulting from a new GRS-guideline for the composition of reports. Tables and pictures, however, are presented as in the two preceding annual reports in order to facilitate direct comparison. As usual up to now, the terms 'shift supervisor' and 'reactor operator' occurring frequently have occasionally be replaced by the abbreviation SL and RO. When studying the reprot it is recommended to first look at the tables and pictures in the appendix. The reader in haste will get a quick survey of the expert training and the practical experience of the candidates as well as on the surrounding field and the results of the examinations. The tables and pictures are discussed and evaluated, followed by summaries and recommendations intended to make the training of the responsible shift personnel of nuclear power plants in the Federal Republic of Germany still more effective and more uniform.

6785 **(INER—0474) Uranium utilization improvement in LWR.** Yang, C.Y. (Institute of Nuclear Energy Research, Lung-Tan (Taiwan). Technical Information Center). Sep 1982. 33p. (CONF-8209261—1). NTIS (US Sales Only), PC A03/MF A01. File Number DE85900137.

From CNS/ANS Taiwan Section topical meeting on nuclear fuel cycle technology; Taipei, Taiwan (29 Sep 1982).

The fertile-to-fissile conversion ratio of current LWR ranges from 0.4 to 0.6, which corresponds to an utilization of about 0.6% of the potential nuclear energy reserved in the natural uranium resource used, if reprocessing is not allowed. With fuel recycling adopted, the uranium utilization factor of the LWR can be raised to about 1%, which is still far from satisfaction. A concept of improving a lot the uranium utilization and in the meantime, retaining most of current LWR technology was investigated here. The results showed that with mixed oxide fuel, a high conversion light water reactor (HCLWR) fuel can be easily designed to have a conversion ratio of as high as 0.95, corresponding to an uranium utilization of about 6 to 10%. However, if plutonium fuel is not to be used, an all uranium oxide fuel still can be designed to have a conversion ratio higher than 0.8. During the past years, J.P. Chien and two of his colleagues in INER had developed two methods for improving the fuel design by properly utilizing the Pb (or Bi) inelastic scattering effects and the Be (n,2n) effects. Application of one of these two methods in the HCLWR fuel design showed that an increase of about 5mk in reactivity can be easily attained without sacrificing significantly the value of conversion ratio and thus the uranium utilization.

6786 **(NUREG/CR—3971) Handbook for cost estimating. A method for developing estimates of costs for generic actions for nuclear power plants.** Ball, J.R.; Cohen, S.; Ziegler, E.Z. (Argonne National Lab., IL (USA); Cohen (S.) and Associates, Inc., McLean, VA (USA); United Engineers and Constructors, Inc., Philadelphia, PA (USA)). Oct 1984. Contract W-31-109-ENG-38. 188p. (ANL/EES-TM—265). NTIS, PC A09/MF A01 - GPO. File Number TI85002585.

This document provides overall guidance to assist the NRC in preparing the types of cost estimates required by the Regulatory Analysis Guidelines and to assist in the assignment of priorities in resolving generic safety issues. The Handbook presents an overall cost model that allows the cost analyst to develop a chronological series of activities needed to implement a specific regulatory requirement throughout all applicable commercial LWR power plants and to identify the significant cost elements for each activity. References to available cost data are provided along with rules of thumb and cost factors to assist in evaluating each cost element. A suitable code-of-accounts data base is presented to assist in organizing and aggregating costs. Rudimentary cost analysis methods are described to allow the analyst to produce a constant-dollar, lifetime cost for the requirement. A step-by-step example cost estimate is included to demonstrate the overall use of the Handbook.

### 2109 Process Heat Reactors

*REFER ALSO TO CITATION(S) 2109006837, 6892*

## 22 NUCLEAR REACTOR TECHNOLOGY

6787 **(INIS-mf—9163) Present state of nuclear industry in France.** (Deutsches Atomforum e.V., Bonn (Germany, F.R.)). 16 Feb 1983. 12p. (In German). (CONF-8311215—). NTIS (US Sales Only), PC A02/MF A01. File Number DE85780182.

From Conference on the Deutsches Atomforum e.V.: on the present state of nuclear industry in France; Bonn, F.R. Germany (28 Nov 1983).

A short history of nuclear industry in France covering the past 20 years is followed by a description of the activities carried out by nuclear industries in France. Progressive detachment from foreign dependencies in reactor technology and rapid organization of its own fuel cycle industry characterize France's nuclear energy policy. In 1983, appr. 40% of the electric energy were generated in nuclear power plants.

6788 **(INIS-mf—9183) Deutsches Atomforum e.V. - annual report 1983.** (Deutsches Atomforum e.V., Bonn (Germany, F.R.)). 1984. 68p. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE85780193.

Report on the activities, organisation, and tasks of Deutsches Atomforum e.V. in 1983.

## 2201 Theory And Calculation

*REFER ALSO TO CITATION(S) 2201006769, 6809*

## 2202 Components And Accessories

*REFER ALSO TO CITATION(S) 2202006840, 6841, 6848*

6789 **(CONF-8410142—38) Aging of cast duplex stainless steels in LWR systems.** Chopra, O.K.; Chung, H.M. (Argonne National Lab., IL (USA)). Oct 1984. Contract W-31-109-ENG-38. 21p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85003023.

From 12. water reactor safety research information meeting; Gaithersburg, MD, USA (23 Oct 1984).

A program is being conducted to investigate the significance of in-service embrittlement of cast duplex stainless steels under light-water reactor operating conditions. The existing data are evaluated to determine the expected embrittlement of cast components during the operating lifetime of reactors and to define the objectives and scope of the investigation. This presentation describes the status of the program. Data for the metallurgical characterization of the various cast stainless steels used in the investigation are presented. Charpy impact tests on short-term aged material indicate that CF-3 stainless steels are less susceptible to embrittlement than CF-8 or CF-8M stainless steels. Microstructural characterization of cast stainless steels that were obtained from Georg Fischer Co. and aged for up to 70,000 h at 300, 350, and 400°C reveals the formation of four different types of precipitates that are not $\alpha'$. Embrittlement of the ferrite phase is primarily due to pinning of the dislocations by two of these precipitates, designated as Type M and Type X. The ferrite phase is embrittled after ~ 8 y at 300°C and shows cleavage fracture. Examination of the fracture surfaces of the impact-test specimens indicates that the toughness of the long-term aged material is determined by the austenite phase. 8 figures, 3 tables.

6790 **(HEDL-SA—3064A) Non-destructive determination of reactor pressure vessel neutron exposure by continuous gamma-ray spectrometry.** Gold, R.; McElroy, W.N.; Kaiser, B.J.; McNeece, J.P. (Hanford Engineering Development Lab., Richland, WA (USA)). Dec 1983. Contract AC06-76FF02170. 6p. (CONF-840902—12). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85001496.

From 5. ASTM-Euratom symposium on reactor dosimetry; Geesthacht, F.R. Germany (24 Sep 1984).

Neutron induced radiation damage experienced by the pressure vessel of a power reactor can be a controlling factor in defining the effective life of plant operation. As a consequence, methods of quantifying the neutron exposure fluence of reactor pressure vessels are of worldwide interest. To this end, a new nondestructive method of reactor pressure vessel neutron dosimetry is advanced. It is based on the observtion of characteristic gamma-rays emitted by activation products in the reactor pressure vessel with a unique Si(Li) Compton continuous gamma-ray spectrometer. 5 references (extended abstract).

6791 **Ultrasonic search head for automated examinations.** Mikesell, C.R.; Beller, L.S.; Hendricks, H.R.; Holm, J.A. (EG & G Idaho, Inc., Idaho Falls, Idaho). *American Society of Mechanical Engineers, [Paper]*; **84-PVP-22**: 8(Jun 1984). (CONF-840647—).

From ASME pressure vessel and piping conference; San Antonio, TX, USA (17 Jun 1984).

A miniature ultrasonic search head was developed for computer-controlled inservice inspection of nuclear piping weldments. Major performance objectives were increasing data reproducibility and versatility of inspection techniques and reducing radiation exposure for certified Level II inspectors. The fluid-filled search head houses a toroidal axicon lens, transducer, and folded mirror system that produces either a small diameter near-parallel beam or a defocused beam. The folded mirror system also provides a long fluid path, thus eliminating multiple echoes during the inspection period. Monitoring of beam characteristics and operation of the linear and two angular motions are computer controlled. Data reproducibility is improved by computer control and monitoring of acoustic and mechanical performance characteristics. Versatility is achieved through varied beam shapes and orientations and the flexible diaphragm which permits scanning simple or complex shapes. Extensive automation of field operational steps allows the Level II inspectors, who are in short supply because of radiation "burnout", to function primarily from the radiation-free computer console.

6792 **Three-dimensional finite element analysis of a scale model nuclear containment vessel.** Derbalian, G.; Fowler, G.; Thomas, J. (Failure Analysis Associates, Palo Alto, California). *American Society of Mechanical Engineers, [Paper]*; **84-PVP-55**: 10(Jun 1984). (CONF-840647—).

From ASME pressure vessel and piping conference; San Antonio, TX, USA (17 Jun 1984).

Current design procedures for nuclear containment vessels are based on elastic analyses. Though such techniques are adequate under normal operating conditions, if the potential risks associated with extreme environments or accident conditions are to be assessed, knowledge of the ultimate capacity of the containment structure is essential. A key technical question is whether penetrations, such as personnel hatches, weaken the containment structure. In this paper, the maximum pressure sustained by a scale model, steel, nuclear containment vessel with a penetration is determined using a threedimensional finite element analysis. To assess containment strength, a clean shell is analyzed in closed form for its ultimate strength, and the solution is then compared with finite element results for a structure that has a penetration. The comparison shows that the personnel hatch penetration does not reduce the ultimate strength of the containment structure. In this paper, it is assumed that the materials have no flaws and welded joints are perfectly bonded. Cracks in the structure, which would degrade its strength, are not considered.

6793 **Slideline verification for multilayer pressure vessel and piping analysis including tangential motion.** Van Gulick, L.A. (Los Alamos National Laboratory, Los Alamos, New Mexico). *American Society of Mechanical Engineers, [Paper]*; **84-PVP-23**: 6(Jun 1984). (CONF-840647—).

From ASME pressure vessel and piping conference; San Antonio, TX, USA (17 Jun 1984).

Nonlinear finite element computer codes with slideline algorithm implementations are useful for the analysis of prestressed multilayer pressure vessels and piping. This paper presents closed form solutions including the effects of tangential motion useful for verifying slideline implementations for this analysis. The solutions describe stresses and displacements of a long internally pressurized elastic-plastic cylinder initially separated from an elastic outer cylinder by a uniform gap. Comparison of closed form and finite element results evaluates the usefulness of the closed form solution and the validity of the slideline implementation used.

6794 **Application of Johnson noise thermometry to the calibration of platinum resistance thermometers in nuclear power plants.** Blalock, T.V. (Electrical Engineering Department of The University of Tennessee and The Oak Ridge National Laboratory, Knoxville and Oak Ridge, TN). pp 58 of Shaping our energy future. Knoxville, TN, USA; LTM Consultants (1984). (CONF-840229—).

From 11. annual WATTec conference and exposition - shaping our energy future; Knoxville, TN, USA (21 Feb 1984).

Abstract only.

A Johnson noise power thermometer (JNPT) has been developed and applied to the in-situ calibration of platinum resistance thermometers in nuclear power plants. The JNPT measured the open-circuit noise voltage and the short-circuit noise current from a sensing resistor. These data were used to calculate the absolute temperature and the resistance of the resistor. The measurement uncertainty in temperature and resistance is less than + or - 0.5% (99% confidence) for sensing resistors from 50 to 300Ω over a temperature range from 273 to 1000 K, using signal cables as long as 18m. Work is continuing using signal cables up to about 50m in length. The errors due to signal cable parameters were corrected by employing computer algorithms based on either lumped-element or distributed-parameter models.

6795 **(RISLEY-Trans—4189) Ultrasonic testing of reactor components for cracks under the cladding.** Kolb, K.; Woelfel, M. Translated from *Materialpruefung ;* **16**: No. 3, 74-75(Mar 1974). 5p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85900051. DE85900051

In the performance of ultrasonic tests to detect sub-cladding cracks, special measures have enabled the reliability of tests to be improved compared with testing with the fixed block-probe. This has been made possible through the development of an adjustable probe unit; the technical features of the latter and results obtained with it are described here.

## 2204 Control Systems

6796 **(INIS-mf—9182) Development and study of a control and reactor shutdown device for FBR-type reactors with a modified open core.** Goswami, S. (Bochum Univ. (Germany, F.R.). Abt. fuer Maschinenbau). 8 Feb 1983. 132p. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number DE85780180.

The doctoral thesis at hand presents a newly designed control and shutdown device to be used for output control and fast shutdown of modified open core FBR-type reactors. The task was the design of a new control and shutdown device having economic and operation advantages, using reactor components time-tested under reactor conditions. This control and shutdown device was adapted to the specific needs concerning dimensions and design. The actuation is based on the magnetic-jack principle, which has been upgraded for the purpose. The principle is now combined with pneumatic acceleration. The improvements mainly concern a smaller number of piece parts and system simplification.

## 2205 Environmental Aspects

*REFER ALSO TO CITATION(S) 2205007381, 7415*

6797 **(BMI—1984-041) Investigations on the aging of activated carbons in the exhaust air of a pressurized water reactor (PWR 4).** Deuber, H.; Gerlach, K. (Bundesministerium des Innern, Bonn (Germany, F.R.); Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Lab. fuer Aerosolphysik und Filtertechnik 1). Jun 1984. 39p. (In German). (KFK—3711). NTIS (US Sales Only), PC A03/MF A01. File Number DE84752334.

Investigations were performed on the aging of five activated carbons in the containment exhaust air of a German pressurized water reactor to find out whether longer stay times can be obtained with activated carbons other than that usually employed (207B (KI)) in the Federal Republic of Germany. The aging with respect to the retention of methyl iodide ($CH_3{}^{131}I$) was smaller with activated carbons impregnated with KIsub(x) only than with those impregnated additionally or exclusively with a tertiary amine (e.g. TEDA). However, because of the better performance without aging, the best retention was found with the TEDA (only) impregnant.

6798 (INIS-mf—9071, pp 68) **Radioactivity studies in the environment of the PAKS Nuclear Power Plant.** Kurczne Csiky, I.; Hollandne Bekesi, E.; Kurtacs, E.; Szabo, G.; Varteresz, V.; Csepregi, T.; Stur, D. (Orszagos Frederic Joliot-Curie Sugarbiologiai es Sugaregeszseguegyi Kutato Intezet, Budapest (Hungary)). 1984. (In Hungarian). NTIS (US Sales Only), PC A04/MF A01. File Number TI85780132. (CONF-8404195—Summ.).

From Training course on radiation protection; Balatonkenese, Hungary (11 Apr 1984).

6799 (INIS-mf—9071, pp 26) **In-situ environmental dose rate measurements by Ge(Li) spectrometry.** Zombori, P.; Nemeth, I.; Andrasi, A. (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics); German, E.; Kemenes, L. (Paksi Atomeroemue Vallalat (Hungary)). 1984. (In Hungarian). NTIS (US Sales Only), PC A04/MF A01. File Number TI85780132. (CONF-8404195—Summ.).

From Training course on radiation protection; Balatonkenese, Hungary (11 Apr 1984).

6800 (INIS-mf—9071, pp 55) **Evaluation of the monitoring signals of water radioactivity at the PAKS Nuclear Power Plant.** Nagy, G.; Deme, S. (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). 1984. (In Hungarian). NTIS (US Sales Only), PC A04/MF A01. File Number TI85780132. (CONF-8404195—Summ.).

From Training course on radiation protection; Balatonkenese, Hungary (11 Apr 1984).

## 2206 Research, Test, And Experimental Reactors

*REFER ALSO TO CITATION(S) 2206006475, 6770, 6772, 6773, 6854, 6862*

6801 **(CONF-8410173—2) Postirradiation examination of high-U-loaded low-enriched $U_3O_8$, $UAl_3$, and $U_3Si$ test fuel plates.** Gomez, J.; Morando, R.; Perez, E.E.; Giorsetti, D.R.; Copeland, G.L.; Hofmann, G.; Snelgrove, J.L. (Oak Ridge National Lab., TN (USA); Comision Nacional de Energia Atomica, Buenos Aires (Argentina); Argonne National Lab., IL (USA)). 1984. Contract AC05-84OR21400. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85002250.

From International meeting on reduced enrichment for research and test reactors; Argonne, IL, USA (14 Oct 1984).

The scope of this work is to present an evaluation of the postirradiation examination of the second set of high-U-loaded low-enriched $U_3O_8$, $UAl_3$ and $U_3Si$ miniature plates manufactured by the Comision Nacional de Energia Atomica (CNEA) of Argentina, and irradiated and examinated, within the framework of the Reduced Enrichment Research and Test Reactor (RERTR) Program, at Oak Ridge National Laboratory and Argonne National Laboratory. This paper includes fabrication details of the plates, their irradiation history and the results of postirradiation examination which are compared to those of the previous test and to present results from other laboratories participating in the RERTR Program. Postirradiation examination of these plates showed satisfactory poerformance for the oxides, aluminides and silicides (except for the highest-loaded $U_3Si$ plate) with the only indication of detrimental behavior during the slight bowing of some plates at about 80% burnup.

6802 **(HEDL-SA—3102) Evaluation of neutron flux in the Pool Critical Assembly.** Lippincott, E.P.; Ruddy, F.H.; Gold, R.; Kellogg, L.S.; Roberts, J.H. (Hanford Engineering Development Lab., Richland, WA (USA)). Sep 1984. Contract AC06-76FF02170. 9p. (CONF-840902—15). NTIS, PC A02/MF A01; GPO Dep. File Number DE85001202.

From 5. ASTM-Euratom symposium on reactor dosimetry; Geesthacht, F.R. Germany (24 Sep 1984).

A recently completed series of experiments in the Pool Critical Assembly (PCA) at Oak Ridge National Laboratory (ORNL) provided extensive neutron flux characterization of a mockup pressure vessel configuration. Considerable effort has been made to understand the uncertainties of the various measurements made in the PCA and to resolve discrepancies in the data. Additional measurements are available for similar configurations in the Oak Ridge Reactor-Poolside Facility (ORR-PSF) at ORNL and in the NESDIP facility in the UK. Comparisons of these results, together with associated neutron field calculations, enable a better evaluation of the actual uncertainties and realistic limits of accuracy to be assessed. Such assessments are especially valuable when the accuracy improvements of benchmark referencing are to be included and extrapolations to new configurations are made.

6803 **(HEDL-SA—3107-FP) Fuel burnup measurements in FFTF.** Rawlins, J.A.; Wootan, D.W.; Dobbin, K.D. (Hanford Engineering Development Lab., Richland, WA (USA)). Aug 1984. Contract AC06-76FF02170. 11p. (CONF-840901—18). NTIS, PC A02/MF A01; GPO Dep. File Number DE85000296.

From ANS topical meeting on reactor physics and shielding; Chicago, IL, USA (17 Sep 1984).

Fuel burnup and isotopic fission rates were measured in FFTF during acceptance testing in an 8.6 day full power irradiation. Results were compared with three-dimensional diffusion theory calculations based on ENDF/B-V cross sections. A bias of about 3% exists between burnup and fission rate data, although measured axial and radial profiles are in good agreement. The calculated and measured radial power distributions are in disagreement by 6 to 10% from core center to the outer row of fuel. At core center, calculation/experiment (C/E) for isotopic fission rates is generally 1.01 while C/E for burnup is 1.04. Overall measurement uncertainties are 3% and 2% for fission rate and burnup experiments, respectively. Application of the results to a long-range goal of calculating burnup to 1% accuracy is discussed.

6804 (Juel-Spez—255, pp 62-63) **Spectrum of $\gamma$ radiation emitted in the FRJ-1 (Merlin) reactor core and moderator region.** Bechteler, H.; Faissner, H.; Yogeshwar, R.; Seyfarth, H. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

## 2207 Plutonium And Isotope Production Reactors

*REFER ALSO TO CITATION(S) 2207006474, 6773*

6805 (ORNL/TM—8872) **Operating and maintenance manual for the HFIR production model homogeneity scanner.** Reynolds, J.W.; Shipp, R.L.; Sliski, T.F.; Longaker, W.H.; Klindt, K.K. (Oak Ridge National Lab., TN (USA)). Dec 1984. Contract AC05-84OR21400. 70p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85004391.

The fuel material in a HFIR fuel is $U_3O_8$ dispersed in aluminum, resembling an airfoil in cross section. To ensure uniform generation of heat within the plate, all plates must be tested (nondestructively) to determine that the $U_3O_8$ content is within specified limits. The HFIR homogeneity scanner developed for this purpose is a density/thickness gauge that bombards a plate with a highly collimated, 0.062-in.-diam beam of x rays and detects those transmitted through the plate. Variations in the transmitted x rays due to absorption in the fuel plate are a measure of fuel denisty. In addition to the fuel plates for HFIR, fuel plates for several other reactors, such as the Oak Ridge Research Reactor (ORR) are also checked by the homogeneity scanner by using other sets of standards. All of the other reactors have a uniform cross section. This manual describes procedures for its electronic components.

## 2208 Propulsion Reactors

*REFER ALSO TO CITATION(S) 2208006774*

6806 (LA-UR—84-3440) **Space nuclear-power reactor design based on combined neutronic and thermal-fluid analyses.** Koenig, D.R.; Gido, R.G.; Brandon, D.I. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 36p. (CONF-850103—3). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85002433.

From 2. symposium on space nuclear power systems; Albuquerque, NM, USA (14 Jan 1985).

The design and performance analysis of a space nuclear-power system requires sophisticated analytical capabilities such as those developed during the nuclear rocket propulsion (Rover) program. In particular, optimizing the size of a space nuclear reactor for a given power level requires satisfying the conflicting requirements of nuclear criticality and heat removal. The optimization involves the determination of the coolant void (volume) fraction for which the reactor diameter is a minimum and temperature and structural limits are satisfied. A minimum exists because the critical diameter increases with increasing void fraction, whereas the reactor diameter needed to remove a specified power decreases with void fraction. The purpose of this presentation is to describe and demonstrate our analytical capability for the determination of minimum reactor size. The analysis is based on combining neutronic criticality calculations with OPTION-code thermal-fluid calculations.

6807 (TID/SNA—1951) **Facility requirements document: NRDS test cell C single NERVA turbopump facility.** (Aerojet Nuclear Systems Co., Sacramento, CA (USA)). Oct 1971. 53p. NTIS, PC A04. File Number DE84017125.

This document contains basic facility requirements needed to scope the facility engineering and modification activities related to the NERVA single turbopump testing to be conducted at Test Cell C, NRDS.

## 2209 Reactor Safety

*REFER ALSO TO CITATION(S) 2209006532, 6786, 7236, 7244, 7473*

6808 (ALO—1023) **Application of an LWR operator information systems analysis to the Calvert Cliffs Nuclear Power Plant-Unit 1.** (Maryland Univ., College Park (USA). Research Foundation; Combustion Engineering, Inc., Windsor, CT (USA); Baltimore Gas and Electric Co., MD (USA)). 24 May 1984. Contract AC04-76DP00789. 148p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE85003444.

This report describes the formulation and demonstration of a method to help utilities achieve their objectives of nuclear plant safety and economy. Called The Integrated Approach to Economic and Safe Nuclear Power Production, it is a framework for showing how plant equipment and personnel work together in successful nuclear operations. It is being applied to the Calvert Cliffs Nuclear Power Plant Unit 1 to evaluate the current plant information systems and, should it appear to be desirable, to identify potential cost-beneficial improvements to plant information systems.

6809 (BMI—1984-040) **FELIX - a computer program for the simulation of criticality excursions in aqueous fissionable materials solutions.** Weber, J.; Denk, W. (Bundesministerium des Innern, Bonn (Germany, F.R.); Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). Jun 1984. 26p. (In German). (GRS-A—936). NTIS (US Sales Only), PC A03/MF A01. File Number DE84752335.

Knowledge of characteristic parameters like evolved power and fission yield during an accidental criticality excursion is of essential importance to estimate possible radiological consequences and resulting safety hazards. The computer code "FELIX" simulates excursion characteristics of aqueous critical assemblies: Starting out from given initial conditions the space-dependent neutron kinetic equations are solved in one-dimensional geometry. Power, fission yield, reactivity and temperature are calculated as a function of time. Reactivity-feedback includes density effects and radiolytic gas voids. Results from calculations and CRAC-experiments are compared in two cases.

6810 (BNL-NUREG—27561) **Correlation of local heat flux from inclined volume-heated pools in bubbly flow.** Greene, G.A.; Abuaf, N.; Jones, O.C. Jr. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract AC02-76CH00016. 9p. (CONF-800723—4). NTIS, PC A02/MF A01 - GPO. File Number TI85003569.

From 19. national heat transfer conference; Orlando, FL, USA (27 Jul 1980).

Local and average heat transfer from volume-boiling pools in the two-phase bubbly flow regime to vertical and inclined flat boundaries were measured. The experimental technique and newly developed gold electroplated microthermocouples to make the measurements are described. A modification to the Boussinesq approximation for liquids is outlined which includes the effect of the average void fraction in a modified Rayleigh number. Heat transfer to vertical and inclined surfaces is correlated in a fashion similar to natural convection in the bubbly flow regime. These new correlations agreed in general with those based on average heat transfer data obtained by Gabor et al. The data from one reference, however, were found to lie significantly below the present data on an average as well as local basis.

**6811 (BNL-NUREG—27594) Analysis of a passive ex-vessel core retention device during a postulated core melt event.** Pratt, W.T.; Gasser, R.D. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract AC02-76CH00016. 16p. (CONF-800403—44). NTIS, PC A02/MF A01 - GPO. File Number TI85003570.

From ANS thermal reactor safety meeting; Knoxville, TN, USA (8 Apr 1980).

An assessment has been carried out on the penetration of a molten core into a passive ex-vessel retention device (constructed from MgO). The MELSAC computer code has been developed to model molten $UO_2$ penetrating MgO. The model also accounts for the feedback effect of heating-up surrounding structures. The sensitivity of MgO penetration and heating-up of structures to a range of MELSAC input variables was evaluated. The scoping study indicated that the amount of heat that can be rejected to structures above the pool tends to control the penetration of MgO. The installation of a core retention device greatly increases the time at which a molten core would be released from containment. However, structures in the reactor cavity would have to be protected to prevent damage by thermal radiation from the pool surface.

**6812 (BNL-NUREG—27595) Shutdown heat removal system reliability in thermal reactors.** Sun, Y.H.; Bari, R.A. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract AC02-76CH00016. 8p. (CONF-800403—45). NTIS, PC A02/MF A01 - GPO. File Number TI85003568.

From ANS thermal reactor safety meeting; Knoxville, TN, USA (8 Apr 1980).

An analysis of the failure probability per year of the shutdown heat removal system (SHRS) at hot standby conditions for two thermal reactor designs is presented. The selected reactor designs are the Pressurized Water Reactor and the Nonproliferation Alternative System Assessment Program Heavy Water Reactor. Failures of the SHRS following the initiating transients of loss of offsite power and loss of main feedwater system are evaluated. Common mode failures between components are incorporated in this anlaysis via the $\beta$-factor method and the sensitivity of the system reliability to common mode failures is investigated parametrically.

**6813 (BNL-NUREG—29814) Thermal analysis of PWR vessel failure due to debris/vessel interaction.** Yang, J.W. (Brookhaven National Lab., Upton, NY (USA)). 1981. Contract AC02-76CH00016. 6p. (CONF-811103—36). NTIS, PC A02/MF A01 - GPO. File Number TI85003648.

From ANS winter meeting; San Francisco, CA, USA (29 Nov 1981).

The modified model represents a more realistic approach and predicts a longer time to vessel breach. External vessel cooling could help to maintain the integrity of the lower head, but the melting of the upper internal structure may cause massive collapse of these structures into the core debris in the lower head. More experiments on molten pools containing frozen particles in hemispheric containers are needed to improve the analytical model.

**6814 (BNL-NUREG—35180) Transient moisture migration in concrete during severe reactor accidents.** Kroeger, P.G.; Shiina, Y. (Brookhaven National Lab., Upton, NY (USA)). 1984. Contract AC02-76CH00016. 14p. (CONF-840914—17). NTIS, PC A02/MF A01 - GPO. File Number TI85000589.

From International meeting on thermal nuclear reactor safety; Karlsruhe, F.R. Germany (10 Sep 1984).

In the most severe hypothetical core heatup accidents in High Temperature Gas Cooled Reactors, the heatup of the concrete reactor vessel can result in gas release from degrading concrete which can ultimately lead to containment building failure. This gas release is largely affected by the moisture migration during concrete heatup. Moisture migration in concrete is also of interest in Light Water Reactors (LWR) core meltdown accidents. Therefore, the general problem of moisture migration in a heated concrete slab has been analyzed, including the effect of water evaporating close to the heated surface and recondensing in cooler regions. Results for early phases of core heatup transients are being given. Their implication on the accident progression is being discussed.

**6815 (BNL-NUREG—35281) Plant analyzer for high-speed interactive simulation of BWR plant transients.** Cheng, H.S.; Lekach, S.V.; Mallen, A.N.; Wulff, W.; Cerbone, R.J. (Brookhaven National Lab., Upton, NY (USA)). 1984. Contract AC02-76CH00016. 12p. (CONF-841075—4). NTIS, PC A02/MF A01 - GPO; GPO Dep. File Number TI85001234.

From International thermal hydraulics and plant operations topical meeting; Taipei, Taiwan (22 Oct 1984).

A combination of advanced modeling techniques and modern, special-purpose peripheral minicomputer technology was utilized to develop a plant analyzer which affords realistic predictions of plant transients and severe off-normal events in LWR power plants through on-line simulations at speeds up to 10 times faster than actual process speeds. The mathematical models account for nonequilibrium, nonhomogeneous two-phase flow effects in the coolant, for acoustical effects in the steam line and for the dynamics of the entire balance of the plant. Reactor core models include point kinetics with reactivity feedback due to void fraction, fuel temperature, coolant temperature, and boron concentration as well as a conduction model for predicting fuel and clad temperatures. Control systems and trip logic for plant protection systems are also simulated. The AD10 of Applied Dynamics International, a special-purpose peripheral processor, is used as the principal hardware of the plant analyzer.

**6816 (BNL-NUREG—35282) Standard problems to evaluate piping response computer codes.** Bezler, P.; Subudhi, M. (Brookhaven National Lab., Upton, NY (USA)). 1984. Contract AC02-76CH00016. 12p. NTIS, PC A02/MF A01 - GPO. File Number TI85000888.

A program has been underway to evaluate the analysis methods used by industry to qualify nuclear power plant piping. Two objectives of this program are to develop physical benchmarks for validating the accuracy of computer codes used to simulate piping response and to develop improved procedures for calculating the response of multiple supported piping with independent seismic inputs. The status of the program in these two areas is reviewed.

**6817 (BNL-NUREG—35287) Transient quenching of superheated debris beds during bottom reflood.** Tutu, N.K.; Ginsberg, T.; Klein, J.; Schwarz, C.E.; Klages, J. (Brookhaven National Lab., Upton, NY (USA)). 1984. Contract AC02-76CH00016. 16p. (CONF-841174—8). NTIS, PC A02/MF A01 - GPO. File Number TI85000885.

From 5. information exchange meeting on debris coolability; Los Angeles, CA, USA (7 Nov 1984).

The experimental data suggest that for small liquid supply rate and low initial particle temperature, the bed quench process is a one-dimensional frontal phenomenon. The bed heat flux is constant during most of the duration of the quench period. The range of conditions which display one-dimensional frontal cooling characteristics is identified as the deep bed regime of bed quenching, and a limiting mathematical model was developed to describe the observed behavior. For large liquid supply rate and high initial bed temperature, the bed quench process is a complex phenomenon. Under these conditions, the bed heat flux displays a nonuniform time dependence. In order to characterize this shallow bed regime, it was necessary to develop a detailed transient model of the coolant-debris interaction. This model, while developed for the shallow bed regime, also applies to the deep bed regime. Numerical computations clearly demonstrate the importance of developing a general reliable model for the solid-fluid heat transfer coefficients.

**6818 (CONF-840816—23) Analysis of hydrodynamic phenomena in simulant experiments investigating cavity interactions following postulated vessel meltthrough.** Sienicki, J.J.; Spencer, B.W. (Argonne National Lab., IL (USA)). 1984. Contract W-31-109-ENG-38. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003044.

From 22. national heat transfer conference; Niagara Falls, NY, USA (5 Aug 1984).

An analysis of hydrodynamic phenomena in simulant experiments examining aspects of ex-vessel material interactions in a PWR reactor cavity following postulated core meltdown and localized breaching of the reactor vessel has been carried out. While

previous analyses of the tests examined thresholds for the onset of sweepout of fluid from the cavity, the present analysis considers the progression of specific hydrodynamic phenomena involved in the dispersal process: crater formation due to gas jet impingement, radial wave motion and growth, entrainment and transport of liquid droplets, liquid layer formation due to droplet recombination, fluidization of liquid remaining in the cavity, removal of fluidized liquid droplets from the cavity, and the ultimate removal of the remaining liquid layer within the tunnel passageway. Phenomenological models which may be used to predict the phenomena are presented.

6819 **(CONF-841074—2-Rev.) Analysis of the OPERA-15 two-dimensional voiding experiment using the SAS4A code.** Briggs, L.L. (Argonne National Lab., IL (USA)). 1984. Contract W-31-109-ENG-38. 22p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003032.

From Thermohydraulics and boiling in liquid metals conference; Grenoble, France (23 Oct 1984).

Overall, SAS4A appears to do a good job for simulating the OPERA-15 experiment. For most of the experiment parameters, the code calculations compare quite well with the experimental data. The lack of a multi-dimensional voiding model has the effect of extending the flow coastdown time until voiding starts; otherwise, the code simulates the accident progression satisfactorily. These results indicate a need for further work in this area in the form of a tandem analysis by a two-dimensional flow code and a one-dimensional version of that code to confirm the observations derived from the SAS4A analysis.

6820 **(CONF-841115—4) RELAP/MOD1.5 analysis of steam line break transients for a 3-loop and a 4-loop Westinghouse nuclear steam supply system.** Peeler, G.B.; McDonald, T.A.; Kennedy, M.F. (Argonne National Lab., IL (USA)). 1984. Contract W-31-109-ENG-38. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85000578.

From International conference on power plant simulation; Mexico City, Mexico (19 Nov 1984).

RELAP/MOD1.5 (Cycle 31 and 34) calculations were made to assess the assumptions used by Westinghouse (W) to analyze mainsteam line break transients. Models of a W 3-loop and 4-loop nuclear steam supply system were used. Sensitivity studies were performed to determine the effect of the availability of offsite power, break size and initial core power. Comparison with W results indicated that if the assumptions used by W are replicated within the RELAP5 framework, then the W methodology for prediction of the Nuclear Steam Supply System (NSSS) response is conservative for steam line break transients.

6821 **(CONF-8305220—) Probabilistic methods in seismic risk assessment for nuclear power plants: proceedings.** (Lawrence Livermore National Lab., CA (USA); Nuclear Energy Agency, 75 - Paris (France). Committee on the Safety of Nuclear Installations). 1983. Contract W-7405-ENG-48. 475p. (CSNI—76). NTIS, PC A20/MF A01; 1; GPO Dep. File Number DE85003234.

From 2. CSNI specialists meeting on probabilistic methods in seismic risk assessment for nuclear power plants; Livermore, CA, USA (16 May 1983).

The state-of-the-art in seismic risk analysis applied to the design and siting of nuclear power plants was addressed in this meeting. Presentations were entered individually into the date base. (ACR)

6822 **(CONF-8410142—6) Recent activities in the Aerosol Generation and Transport Program.** Adams, R.E. (Oak Ridge National Lab., TN (USA)). 1984. Contract AC05-84OR21400. 15p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85000272.

From 12. water reactor safety research information meeting; Gaithersburg, MD, USA (23 Oct 1984).

General statements may be made on the behavior of single-component and multi-component aerosols in the Nuclear Safety Pilot Plant vessel. The removal processes for $U_3O_8$, $Fe_2O_3$, and $U_3O_8$ + $Fe_2O_3$ aerosols are enhanced in a steam-air atmosphere. Steam-air seems to have little effect on removal of concrete aerosol from the vessel atmosphere. A steam-air environment causes a change in aerosol shape from chain-agglomerate to basically spherical for $U_3O_8$, $Fe_2O_3$, and $U_3O_8$ + $Fe_2O_3$ aerosol; for concrete the change in aerosol shape is from chain-agglomerate to partially spherical. The mass ratio of the individual components of a multi-component aerosol seems to have an observable influence on the resultant behavior of these aerosols in steam. The enhanced rate of removal of the $U_3O_8$, the $Fe_2O_3$, and the mixed $U_3O_8$ + $Fe_2O_3$ aerosols from the atmosphere of the NSPP vessel by steam-air is probably caused by the change in aerosol shape and the condensation of steam on the aerosol surfaces combining to increase the effect of gravitational settling. The apparent lack of an effect by steam-air on the removal rate of concrete aerosol could result from a differing physical/chemical response of the surfaces of this aerosol to condensing steam.

6823 **(CONF-8410142—7) Measurement of response time and detection of degradation in pressure sensor/sensing line systems.** Buchanan, M.E.; Fry, D.N.; Kerlin, T.W.; Miller, L.F.; Thie, J.A.; Ragan, G.E.; March-Leuba, J. (Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville (USA); Analysis and Measurement Services, Knoxville, TN (USA)). 1984. Contract AC05-84OR21400. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85000271.

From 12. water reactor safety research information meeting; Gaithersburg, MD, USA (23 Oct 1984).

The results are presented of performance tests on pressure sensors for LWR forced convection test facility.

6824 **(CONF-8410142—8) Effects of improved modeling on best estimate BWR severe accident analysis.** Hyman, C.R.; Ott, L.J. (Oak Ridge National Lab., TN (USA)). 1984. Contract AC05-84OR21400. 22p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85000593.

From 12. water reactor safety research information meeting; Gaithersburg, MD, USA (23 Oct 1984).

Since 1981, ORNL has completed best estimate studies analyzing several dominant BWR accident scenarios. These scenarios were identified by early Probabilistic Risk Assessment (PRA) studies and detailed ORNL analysis complements such studies. In performing these studies, ORNL has used the MARCH code extensively. ORNL investigators have identified several deficiencies in early versions of MARCH with regard to BWR modeling. Some of these deficiencies appear to have been remedied by the most recent release of the code. It is the purpose of this paper to identify several of these deficiencies. All the information presented concerns the degraded core thermal/hydraulic analysis associated with each of the ORNL studies. This includes calculations of the containment response. The period of interest is from the time of permanent core uncovery to the end of the transient. Specific objectives include the determination of the extent of core damage and timing of major events (i.e., onset of $Zr/H_2O$ reaction, initial clad/fuel melting, loss of control blade structure, etc.). As mentioned previously the major analysis tool used thus far was derived from an early version of MARCH. BWRs have unique features which must be modeled for best estimate severe accident analysis. ORNL has developed and incorporated into its version of MARCH several improved models. These include (1) channel boxes and control blades, (2) SRV actuations, (3) vessel water level, (4) multi-node analysis of in-vessel water inventory, (5) comprehensive hydrogen and water properties package, (6) first order correction to the ideal gas law, and (7) separation of fuel and cladding. Ongoing and future modeling efforts are required. These include (1) detailed modeling for the pressure suppression pool, (2) incorporation of $B_4C$/steam reaction models, (3) phenomenological model of corium mass transport, and (4) advanced corium/concrete interaction modeling. 10 references, 17 figures, 1 table.

6825 **(CONF-8410142—40) Results and conclusions from the first pressurized-thermal-shock experiment.** Bryan, R.H.; Bolt, S.E.; Merkle, J.G.; Bass, B.R.; Bryson, J.W.; Robinson, G.C.; Whitman, G.D. (Oak Ridge National Lab., TN (USA)). 1984. Contract AC05-84OR21400. 26p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85003084.

From 12. water reactor safety research information meeting; Gaithersburg, MD, USA (23 Oct 1984).

Pretest estimates of fracture toughness are reasonably close to the PTSE-1 values. Furthermore, the ASME Sect. XI toughness relationships are conservative relative to actual material characteristics. The experiment demonstrated that arrest toughness substantially above the 220 MPa.√m cutoff of Sect. XI could be realized. The arrest values in PTSE-1 also are consistent with arrest measurements made in wide-plate tests and reported by the Japan Welding Council. The highest PTSE-1 value of arrest occurred at a temperature ~ 30 K above the onset of the Charpy upper shelf. This is believed to be very close to the threshold temperature above which cleavage fracture cannot persist. This result also suggests that the methods of linear elastic fracture mechanics have an important role in fracture evaluation at high (upper-shelf) temperatures. The PTSE-1A and -1B transients were a demonstration that simple warm prestressing (K/sub I/ < 0) strongly inhibits crack initiation. With allowance for uncertainty in the true K/sub Ic/ values it is evident that K/sub I/ exceeds K/sub Ic/ during warm prestressing by 50% to 90%. Thus, the effectiveness of simple warm prestressing has now been demonstrated in two experiments with thick cylinders, thermal shock experiment TSE-5A and PTSE-1. In the A transient, simple anti-warm prestressing (K/sub I/ > 0) prevailed during two periods of 40-s and 60-s duration without crack initiation, although K/sub I/ exceeded K/sub Ic/ by 30% to 50%. Clearly simple anti-warm prestressing is not a sufficient condition to alleviate the effects of warm prestressing. A narrow band of ductile tearing formed ahead of the initial cleavage fracture. The conclusions drawn from PTSE-1 suggest that procedures used for evaluating overcooling accidents in pressurized-water reactors should take into consideration realistically the fracture mechanisms that have been clearly demonstrated but not yet generally accepted.

6826 **(EGG-M—04184) Steam generator tube rupture in an experimental facility scaled from a pressurized water reactor.** Loomis, G.G. (Idaho National Engineering Lab., Idaho Falls (USA)). Sep 1984. Contract AC07-76ID01570. 10p. (CONF-841014—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003427.

From International conference on nuclear and radiochemistry; Lindau, Bodensee, F.R. Germany (8 Oct 1984).

Results from an experimental investigation of steam generator tube rupture in the Semiscale Mod-2B system are presented. From the experimental results, the characteristic system response signature for a wide range of number of tubes ruptured has been described. The tube rupture was assumed to occur during normal full power operation (15.6 MPa system pressure, 37°K core differential temperature). In addition, recovery scenarios involving operator actions were examined. The recovery scenarios included use of pressurizer auxiliary spray and internal heaters, steam generator feed and steam, primary feed and bleed, and main cooling pump operation. Recovery scenarios suggested by typical US pressurized water reactor emergency operating procedures were followed.

6827 **(EGG-M—14384) OECD-LOFT Experiment LP-SB-2: a hot leg small break LOCA with pumps on.** Modro, S.M.; Chen, T.H. (EG and G Idaho, Inc., Idaho Falls (USA); Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H.). 1984. Contract AC07-76ID01570. 5p. (CONF-841105—45). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003257.

From Joint meeting of the American Nuclear Society and the Atomic Industrial Forum; Washington, DC, USA (11 Nov 1984).

This paper presents the overall experiment results from OECD-LOFT Experiment LP-SB-2, sponsored by the Organization for Economic Cooperation and Development (OECD), and a comparison with the experiment predictions performed with the RELAP5 code. Experiment LP-SB-2 simulated a 7.6-cm (3-in.) diameter break in a hot leg pipe of a commercial PWR with a delayed primary coolant pump (PCP) trip. This experiment was designed to evaluate the effect of PCP operation on system behavior.

6828 **(EGG-M—15584) Status and application of TRAC-BD1/MOD1 to benchmark data.** Weaver, W.L. III. (EG and G Idaho, Inc., Idaho Falls (USA)). 1984. Contract AC07-76ID01570. 4p. (CONF-841105—42). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003256.

From Joint meeting of the American Nuclear Society and the Atomic Industrial Forum; Washington, DC, USA (11 Nov 1984).

The TRAC-BD1/MOD1 code can simulate a full range of operational transients and postulated accidents. It has been tested against a range of separate effects and systems test data and the agreement between the code simulation and the test data is good overall but specific areas of improvement remain. Work currently underway includes the development of a one-dimensional neutron kinetics model and a Courant limit violating numerical scheme to increase the computational speed of the code for simulation of long transients.

6829 **(EGG-M—15684) Status and applications of RELAP5/MOD2 to measured data.** Riemke, R.A.; Chow, H.; Kiser, D.M.; Ogden, D.M. (Idaho National Engineering Lab., Idaho Falls (USA)). 1984. Contract AC07-76ID01570. 6p. (CONF-841105—43). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003264.

From Joint meeting of the American Nuclear Society and the Atomic Industrial Forum; Washington, DC, USA (11 Nov 1984).

RELAP5/MOD2 is a pressurized water reactor (PWR) system transient analysis code which can be used for simulation of a wide variety of PWR system transients of interest in light water reactor (LWR) safety analysis. The code models have been designed to permit simulation of postulated accidents ranging from large break loss-of-coolant accidents to operational transients. Purpose of this paper is to present the status of RELAP5/MOD2 and to show calculation results for a SEBAN reflood test, a series of Semiscale natural circulation tests, and a H. B. Robinson Unit 2 main steamline break plant transient.

6830 **(EGG-M—18484) BWR ATWS simulations for Browns Ferry Nuclear Plant Unit 1.** Dallman, R.J. (EG and G Idaho, Inc., Idaho Falls (USA)). 1984. Contract AC07-76ID01570. 14p. (CONF-8410142—54). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003590.

From 12. water reactor safety research information meeting; Gaithersburg, MD, USA (23 Oct 1984).

Under auspices of the US Nuclear Regulatory Commission, simulations of anticipated transients without scram (ATWS) in a boiling water reactor are being performed. A methodology has been developed to study the ATWS, and deterministic analyses have been conducted. Results are presented for one of the most probable (albeit hypothetical) sequences leading to core and containment damage. Areas presenting calculational uncertainties are identified, and requirements for their resolution are proposed.

6831 **(EGG-M—19484) FRAP-T6 code development.** Shah, V.N. (EG and G Idaho, Inc., Idaho Falls (USA)). 1984. Contract AC07-76ID01570. 41p. (CONF-8410142—60). NTIS, PC A03/MF A01; GPO Dep. File Number DE85003415.

From 12. water reactor safety research information meeting; Gaithersburg, MD, USA (23 Oct 1984).

This paper presents the pellet-cladding mechanical interaction (PCMI) models recently incorporated in the FRAP-T6 fuel rod analysis code. Phenomena associated with early axial PCMI, trapped stack, and fuel compliance models are described in detail. FRAP-T6 calculations of cladding elongations and hoop strains are compared with corresponding test measurements for conditions involving pellet-cladding mechanical interaction. Some of the measurements are from two Halden fuel rod experiments: IFA-508 having fresh fuel rods and IFA-512 having fuel rods at moderate burnup. The remaining measurements are from two operational transients performed at the Power Burst Facility: OPTRAN 1-1 and OPTRAN 1-2 simulating operational transients with and without scram, respectively, in a BWR. The comparisons presented in this paper show good agreement between the FRAP-T6 calculations of cladding axial elongation and hoop strain with the corresponding measurements.

6832 **(EGG-M—22884) Effectiveness and safety aspects of selected decontamination methods for LWRs.** Simpson, F.B.; Duce, S.W.; Mandler, J.W. (Idaho National Engineering Lab., Idaho Falls (USA)). 1984. Contract AC07-76ID01570. 15p. (CONF-8410142—61). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003416.

From 12. water reactor safety research information meeting; Gaithersburg, MD, USA (23 Oct 1984).

The Effectiveness and Safety Aspects of Selected Decontamination Methods program objective is to obtain information on chemical decontamination methods that the Nuclear Regulatory Commission (NRC) might be expected to review in the near future. General topic areas are the effectiveness in reducing occupational dose to plant individuals, the volume of radioactive waste generated as a result of decontamination efforts, and plant information that would assist the NRC in their review process. To date, our evaluation has concentrated on decontamination factors (DFs) obtained, methods used in determining DFs, man-rems savings, waste forms generated, man-rem expended in performing the decontamination, and an evaluation of the overall operation (i.e., problems and lessons learned). This paper presents the preliminary results of these evaluations.

6833 **(EGG-M—25384) Nuclear plant simulation using the Nuclear Plant Analyzer.** Beelman, R.J.; Laats, E.T.; Wagner, R.J. (EG and G Idaho, Inc., Idaho Falls (USA)). 1984. Contract AC07-76ID01570. 5p. (CONF-841115—6). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003258.

From International conference on power plant simulation; Mexico City, Mexico (19 Nov 1984).

The Nuclear Plant Analyzer (NPA), a state-of-the-art computerized safety analysis and engineering tool, was employed to simulate nuclear plant response to an abnormal transient during a training exercise at the US Nuclear Regulatory Commission (USNRC) in Washington, DC. Information relative to plant status was taken from a computer animated color graphics display depicting the course of the transient and was transmitted to the NRC Operations Center in a manner identical to that employed during an actual event. Recommendations from the Operations Center were implemented during on-line, interactive execution of the RELAP5 reactor systems code through the NPA allowing a degree of flexibility in training exercises not realized previously. When the debriefing was conducted, the RELAP5 calculations were replayed by way of the color graphics display, adding a new dimension to the debriefing and greatly enhancing the critique of the exercise.

6834 **(EGG-TIO-M—00784) TMI-2 plant demineralizer sample analysis.** Thompson, J.D.; Knauer, J.B. (EG and G Idaho, Inc., Idaho Falls (USA); Oak Ridge National Lab., TN (USA)). 1984. Contract AC07-76ID01570. 4p. (CONF-841105—46). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003263.

From Joint meeting of the American Nuclear Society and the Atomic Industrial Forum; Washington, DC, USA (11 Nov 1984).

The conclusion is that the sequential elution process planned by GPUNC will be effective in Cs elution from the TMI-2 demineralizer resins, the effluent from elution can be filtered through sintered stainless steel media, the SDS system will successfully remove Cs from the eluant, and these conclusions hold even though local temperatures of demineralizer resins reached at least 537°C during the accident.

6835 **(EGG-TMI—6697-Draft) TMI-2 core debris-cesium release/settling test. Draft report.** Akers, D.W.; Johnson, D.A. (EG and G Idaho, Inc., Idaho Falls (USA)). Sep 1984. Contract AC07-76ID01570. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85003401.

Cesium release, turbidity and airborne potential tests were conducted on 50 grams of TMI-2 core debris materials. The tests were performed on the debris in two stages: (1) undisturbed, without fracturing the debris particles; and (2) disturbed, after crushing the debris particles. Crushing the debris had minimal impact on turbidity. In general, the opacity of both solutions decreased at about the same rate (within a factor of 2). Crushing the debris increased the soluble $^{137}Cs$ concentrations a factor of 4 to 5. Most of the airborne activity occurred near the end of the evaporation process, just prior to dryout. The increase in airborne concentration at this time is two to three orders of magnitude higher than at any other time.

6836 **(EPRI-NP—3243-CCM-Vol.1) BEAGL-01: a computer code for calculating rapid LWR core transients. Volume 1. Mathematical modeling. Computer code manual.** Diamond, D.J. (Brookhaven National Lab., Upton, NY (USA)). Oct 1984. Contract AC02-76CH00016. 123p. NTIS, PC A06/MF A01 - EPRI $14.50; GPO Dep. File Number DE85003680.

BEAGL-01 is a computer program for calculating the conditions in a light water reactor core at steady state and while undergoing a transient. It couples a neutron kinetics model in R,Z geometry with a two-phase thermal-hydraulics model for multiple parallel channels. Appropriate applications include reactivity insertion accidents in both pressurized and boiling water reactors and transients in boiling water reactors initiated by perturbations in flow rate, inlet temperature, or pressure. In this volume the modeling of the neutron kinetics, coolant thermal-hydraulics and fuel rod heat conduction are discussed. This includes the basic equations and the numerical algorithms used to solve these equations.

6837 (FS—83-32-T, pp 197-208) **Tritium contamination of process heat HTGR-type reactors exemplified by the process gas producing plant AVR-2.** Buchkremper, H.P.; Hecker, R.; Jonas, H.; Stoever, D. Nov 1983. (In German). Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland). (CONF-8306168—).

From 17. annual meeting of Fachverband fuer Strahlenschutz e.V.; Aachen, F.R. Germany (8 Jun 1983).

The HTGR-type reactor AVR-2 is under discussion as a possible successor project of AVR-1 and/or THTR-300. It is designed to demonstrates the technical feasability of process gas generation and to test related key components. The particular assets of this kind of secondary energy production are impaired by low-level tritium contamination of the process gas if the existing radiation protection regulations are strictly applied to this particular case. The tritium pathway can be described as follows: Tritium production by ternary fission in the core zone and by nuclear reactions both in the care zone and in the reflector zone. Tritium release into the primary circuit. Tritium release into the secondary circuits by permeation. Gas purification system and tritium filters, if any, are tritium reduction devices. Leakages may be neglected. Process gas contamination and dimensioning of the gas purification system can be greatly influenced by the inhibitive action of oxidic layers on metal walls of tubular fission furnaces and integrated steam generators. Suitable oxidic films can reduce hydrogen and tritium permeation by 3 to 4 orders of magnitude as compared to non-oxidized metal. We have in the past attended to developing and testing of such suitable oxidic films.

6838 (FS—83-32-T, pp 296-310) **Radiation protection aspects of inspections at the Neckar reactor site (GKN) with emphasis on contaminations.** Bentele, W.; Woerner, E. Nov 1983. (In German). Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland). (CONF-8306168—).

From 17. annual meeting of Fachverband fuer Strahlenschutz e.V.; Aachen, F.R. Germany (8 Jun 1983).

While radiation protection is mainly concerned with contaminations of the plants and components during nuclear power plant inspections, here is a survey of the most important aspects of radiation protection during inspection. This applies in particular to local dose rates within the plant as well as to work concerned by radiation protection and related safety provisions, and resulting individual doses. Common decontamination methods are listed and assessed. Since for successful inspection in accordance with radiation protection regulations, labour management and measurement monitoring of the various areas under radiation protection are essential, these aspects are also discussed. Furthermore, it is to be critically examined to what extent decontamination methods aiming at reducing individual doses are practice, and whether or not doses received in subsequent waste handling only bring about a shift of individual doses. Steady clean-up of the plant by well-trained and

well-equipped clean-up personnel leads to low-level aerosol and iodine exposure in the air within the plant, and substantially contributes to the prevention of incorporations and emissions with the exhaust air.

6839 (FS—83-32-T, pp 311-321) **Exploitation of experience for the performance of maintenance work in the reactor.** Berg, D.; Knape, H. Nov 1983. (In German). Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland). (CONF-8306168—).

From 17. annual meeting of Fachverband fuer Strahlenschutz e.V.; Aachen, F.R. Germany (8 Jun 1983).

To begin with, reasons are stated explaining why the documentation of maintenance work is necessary to the plant's radiation protection personnel and to the plant layout staff. A selection of examples from plans layout practice is made to slow to what extent the needs of the plant's radiation protection personnel can be considered in the layout by way of secured experience feedback. Forms of presentation of operational results are shown, securing both the documentation of maintenance work (e.g. operation analyses) and long-term radiological changes within systems and/or components thereof (photo documentation). Procedures are presented enabling the practical documentation of operational experience from maintenance work in the reactor in the forms of presentation discussed, allowing for uninterrupted flow of work, during inspections in particular.

6840 (FS—83-32-T, pp 323-333) **Remote control and non-destructive sampling for the determination of contamination in reactor circuits.** Schenker, E.; Hanulik, J.; Goerlich, W. Nov 1983. (In German). Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland). (CONF-8306168—).

From 17. annual meeting of Fachverband fuer Strahlenschutz e.V.; Aachen, F.R. Germany (8 Jun 1983).

A knowledge of contamination type and degree is absolutely necessary to the planning of decontamination and decommission work. To this aim, methods and apparatus were developed which allowed specimens to be removed remotely and nondestructively. Specimens from a range of reactor systems (i.e. AVR, DIORIT, NS 'Otto Hahn', Niederaichbach, etc.) were removed remotely and analysed. Depth profiles were obtained which gave information about the contamination and chemical composition. Activation products such as Fe-55 and Ni-63 were also detected. The results from specimen removal and decontamination are compared.

6841 (FS—83-32-T, pp 335-345) **Quantitative determination of iron-55, nickel-59, and nickel-63 in reactor components.** Goerlich, W.; Schenker, E.; Hanulik, J. Nov 1983. (In German). Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland). (CONF-8306168—).

From 17. annual meeting of Fachverband fuer Strahlenschutz e.V.; Aachen, F.R. Germany (8 Jun 1983).

When evaluating samples from reactor loops for the determination of contaminations by fission and activation products, long-lived $\gamma$-sources such as cobalt-60 and caesium-137, the quantitative determination is fairly easy. There are usually considerable quantities of contaminants in the reactor loops the analysis of which requires greater expenditure in work and money. Such contaminants are for instance the $\beta$-source nickel-63 and the corpuscular radiation source iron-55. We have developed methods for the determination of nickel-63 and iron-55. Results obtained from nuclear power plants and the comparison with activation calculations prove that these methods are applicable.

6842 (FS—83-32-T, pp 347-357) **Radiation protection problems releated to repairs on primary circuit components of an HTR exemplified by the AVR.** Wahl, J. Nov 1983. (In German). Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland). (CONF-8306168—).

From 17. annual meeting of Fachverband fuer Strahlenschutz e.V.; Aachen, F.R. Germany (8 Jun 1983).

The AVR reactor has a graphite-moderated helium-cooled core comprising appr. 100.000 fuel elements. Permanent deposition of graphite dust from the coolant gas, abraded from the fuel element surface is the principal source of contamination of the surfaces exposed to the coolant gas. After about 93.000 operating hours, the surface dose rate caused by graphite dust is on average 0.5 rem/h for $\gamma$-radiation, and 60 rem/h for $\beta$-radiation. With rare exceptions, all components are immersed in water right where they are removed in order to shield radiation and to bind the dust before they are transferred to the decontamination room. After pre-decontamination, the component is disassembled under water as a safeguard against $\beta$-radiation. The subsequent steps of decontamination lead to a surface dose rate below 20 mrem/h for $\gamma$-radiation and 2 rem/h for $\beta$-radiation, with no sign of corrosion of the surface material. The maximum individual dose rate recieved while handling a component, from disassembly to reassembly is 0.4 manrem for the whole body, and 2.5 manrem for the hands.

6843 (FS—83-32-T, pp 361-369) **Contamination of pipes to be exchanged and decontamination at the Wurgassen reactor site.** Brandt, D.; Voelz, E. Nov 1983. (In German). Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland). (CONF-8306168—).

From 17. annual meeting of Fachverband fuer Strahlenschutz e.V.; Aachen, F.R. Germany (8 Jun 1983).

Since June of 1982 the nuclear power station Wuergassen has been out of operation for exchanging pipes within the containment. These pipes are flowed through by materials carrying radioactivity - mainly cobalt-60 - that has deposited on the inside-surface. The resulting radiation exposure outside the pipes at the working places had to be minimized by decontaminating the pipes and by taking other measures against the radiation.

6844 (FS—83-32-T, pp 417-482) **Three Mile Island Unit 2 nuclear power plant four years later.** Peterson, H.K. Nov 1983. Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland). (CONF-8306168—).

From 17. annual meeting of Fachverband fuer Strahlenschutz e.V.; Aachen, F.R. Germany (8 Jun 1983).

The present report is intended to give an overview of the radiological conditions present at TMI with a brief history of what has been accomplished to date and also what is planned for the future. The present status of the Fuel Handling and Auxiliary Buildings is briefly summarized but since the major emphasis has been on the removal of fuel from the reactor vessel, most of the work performed has been in the reactor building. Therefore, most of the discussion in this report involves work which has been performed in the reactor building. Health Physics aspects of the clean-up effort are discussed as are some of the more political problems.

6845 (FS—83-32-T, pp 577-596) **Health physics aspects of the decommissioning of NS 'Otto Hahn'.** Henning, K.D. Nov 1983. (In German). Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland). (CONF-8306168—).

From 17. annual meeting of Fachverband fuer Strahlenschutz e.V.; Aachen, F.R. Germany (8 Jun 1983).

After 10 years of operation the NS 'Otto Hahn' was decommissioned in order to get a conventional merchant ship. The following health physics aspects are considered: Decommissioning concept: Transport of reactor vessel (and shieldings) to GKSS Research Center, also components and systems container conditioned. Licensing procedure: Some typical specialities of a mobile nuclear facility. Personal Dose, Activity Release, Activities and Nuclear Waste: The collective dose was 30 man rem, the emission of aerosol activity 2 $\mu$Ci during the whole time. 14.000 m$^2$ and 375 t were to be decontaminated. Radioactivity control and monitoring: $10^6$ single measurements of activity (mostly via dose rate) were necessary. Experiences: Some tanks had to be treated in a special manner. Expenditure: An extrapolation or transferation of the costs is not possible. In the meantime Otto Hahn is going to be used as a conventional container ship with a speed of 17 kts.

6846 (FS—83-32-T, pp 597-605) **Health physics of the decommissioning of NS 'Otto Hahn' from the decommissioning company's viewpoint.** Hutz, K.H.; Obst, J. Nov 1983. (In German). Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland). (CONF-8306168—).

From 17. annual meeting of Fachverband fuer Strahlenschutz e.V.; Aachen, F.R. Germany (8 Jun 1983).

Some of the points to be discussed in the report are listed below: The essential differences between backfitting measures in current Nuclear Power Plants and in the decommissioning of nuclear facilities will be described. The essential factors for the successful decommissioning of nuclear facilities as structural knowledge of the facilities as well as exact knowledge of the radiological state of the facilities for the selection of work method and work measures as well as for radiation protection measures to be taken. Explanation of the precautionary measures to minimize the aerosol release and the radiation exposure. The aerosol release dependent on the degree of contamination and on the separating procedure selected will be shown on one example for the dismantling of a heat exchanger. Description of the method of procedure to minimize the indivdual dose during decontamination of the fuel element storage pit. For decontamination - whether soft or hard decontamination - in Nuclear Power Plants, the decontamination of the secondary plant of the OTTO HAHN will be described exemplarily. Experience gained when the OTTO HAHN was decommissioned has revealed that the accumulated dose exposure per man and year can be restricted to approx. 15 m Sv (1.500 mrem). Similar values are also to be expected for the decommissioning of Nuclear Power Plants - even if this should take place 5 - 10 years after shutdown.

6847 (FS—83-32-T, pp 607-615) **Health physics aspects of the decommissioning of the Niederaichbach reactor.** Loeschhorn, U.; Birkhold, U.; Obst, J.; Stasch, W. Nov 1983. (In German). Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland). (CONF-8306168—).

From 17. annual meeting of Fachverband fuer Strahlenschutz e.V.; Aachen, F.R. Germany (8 Jun 1983).

The dismantling project for the total removal of the Niederaichbach nuclear power plant required the investigation of all radiological consequences arising from dismantling actions. This included, besides investigations on the aerosol release during the disassembly of reactor components, extensive computation of shielding devices. It is an essential objective to carry out dismantling work with the least possible radiation exposure in accordance with health physics principles (Art. 28 of the Radiative Protection Ordinance). Consequently, the shielding devices were designed so that in permantly accessible areas the close rate does not exceed 0.5 mrem/h. For large components to be dismantled, radiological curves ndose rate/distance) for handlung were established for case-to-case decisions.

6848 (FS—83-32-T, pp 617-624) **Decontamination and disposal of dismantled reactor components.** Laser, M.; Rosenbaum, F.; Schulz, W. Nov 1983. (In German). Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland). (CONF-8306168—).

From 17. annual meeting of Fachverband fuer Strahlenschutz e.V.; Aachen, F.R. Germany (8 Jun 1983).

Dismantled or stripped reactor components are to be utilized in an unharmful way according to stomic law or, in case this is impossible at the present state of science and technology, or not justifiable from the economic policy point of view, or impossible for other important reasons, they are to be orderly disposed of as radioactive waste. Such an important reason excluding rentilization is for instance radiation exposure of the personnel during necessary decontamination work. Decisions for either utilization or waste disposal must be made on careful consideration of the goods in question. Activated dismantled components can not usually be utilized in an unharmful way. They must, therefore, be disposed of as radioactive waste, if required, upon appropriate conditioning. With low-contamination components, e.g. fuel element storage rades, components of the secondary loop of a PWR-type reactor, decontamination is not usually to be excluded owing to radiation exposure of the personnel. Optimization, therefore, will suit economic conveniences. For strongly contaminated components having a surface dose rate of up to 10 R/h, it has proved appropriate to predecontaminate large parts weighing up to 5 tons in chemical cleaning basins. This usually effects a reduction of dose rates down to less than 100 mR/h. Then, dismantling (mechanical or thermal) into convenient-size parts is possible without remote handling. Further decontamination may follow.

6849 (GEND—042) **TMI-2 Reactor Building source term measurements: surfaces and basement water and sediment.** McIsaac, C.V.; Keefer, D.G. (EG and G Idaho, Inc., Idaho Falls (USA)). Oct 1984. Contract AC07-76ID01570. 88p. NTIS, PC A05/MF A01; GPO Dep. File Number DE85003888.

Presented in this report are the results of radiochemical and elemental analyses performed on samples collected from the Three Mile Island Unit 2 Reactor Building from August 1979 to December 1983. The quantities of fission products and core materials that were measured on the external surfaces in the Reactor Building or in the water and sediment in its basement are summarized. Recent analysis results for access panels removed from the air cooling assembly and for liquid and particulate samples collected from the Reactor Building sump and reactor coolant drain tank are included in the report. Measurements show that 59% of the $^{3}H$, 2.7% of the $^{90}Sr$, 15% of the $^{129}I$, 20% of the $^{131}I$, and 42% of the $^{137}Cs$ originally in the core at the time of the accident could be accounted for outside the core in the Reactor Building. With the exceptions of $^{90}Sr$ and $^{144}Ce$, the vast majority of each radionuclide released was found dispersed in the water and sediment in the basement.

6850 (GKSS—84/E/10) **Reflooding phase after loss of coolant of an advanced pressurized water reactor with high conversion ratio.** Schumann, S. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.); Technische Univ. Braunschweig (Germany, F.R.). Fakultaet fuer Maschinenbau und Elektrotechnik). 1984. 186p. (In German). NTIS (US Sales Only), PC A09/MF A01. File Number DE84752311.

The emergency core cooling behaviour of an advanced pressurized water reactor (APWR) during the reflooding phase of the LOCA with double-ended break is analysed and compared to a common pressurized water reactor (PWR). The code FLUT-BS, its models and correlations are explained in detail and have been verified by numerous PWR-reflood experiments with large parameter range. The influence of core-design on ECC-behaviour as well as the influences of initial and boundary values are examined. The results show the essential differences of ECC-behaviour between PWR and APWR.

6851 (GRS—55) **Recommendations of the Reactor Safety Commission (RSK) 1981-1983. Vol. 5.** (Reaktorsicherheitskommission (RSK), Koeln (Germany, F.R.); Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). Feb 1983. 107p. (In German). NTIS (US Sales Only), PC A06/MF A01. File Number DE84752312.

Since the reorganization of the RSK in 1971 the recommendations are published in the "Bundesanzeiger" (BAnz). This makes the work of the RSK transparent for the public. After publication of the recommendations in the Bundesanzeiger, the Office of the RSK publishes them once more as a summary report by order of the Federal Minister of Interior. The reports are divided generally into two parts: Part I contains the recommendations which are given by the RSK; part II contains the official notices concerning the RSK. There is also a subject index. In addition volume 5 contains as part III all papers which were held on the occasion of the 25th anniversary of the Reactor Safety Commission.

6852 (GRS-F—135) **List of reports of BMFT, CEA, EPRI, JSTA and USNRC in the field of reactor safety research.** (Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). Apr 1984. 51p. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE85750010.

The list pursues the following order: Country of origin, problem area concerned, according to the Reactor Safety Research Programm of the BMFT, reporting organization. The list of reports appears quarterly.

6853 (INIS-mf—9071, pp 33) **Data processing system for the official environmental radiation protection monitoring authorities around PAKS.** Kanyar, B.; Laczai, J.; Selmeczi, G.; Szabo, Z.; Sztanyik, B.L. (Orszagos Frederic Joliot-Curie Sugarbiologiai es Sugaregeszseguegyi Kutato Intezet, Budapest (Hungary)). 1984. (In Hungarian). NTIS (US Sales Only), PC A04/MF A01. File Number TI85780132. (CONF-8404195—Summ.).

From Training course on radiation protection; Balatonkenese, Hungary (11 Apr 1984).

6854 (INIS-mf—9071, pp 23) **Measurement of thermal neutron fluxes and gamma dose rates by means of thermoluminescent and activation detection methods at the Training Reactor of the TV Budapest.** Viragh, E.; Zsolnay, E. (Budapesti Mueszaki Egyetem (Hungary). Egyetemi Reaktor). 1984. (In Hungarian). NTIS (US Sales Only), PC A04/MF A01. File Number TI85780132. (CONF-8404195—Summ.).

From Training course on radiation protection; Balatonkenese, Hungary (11 Apr 1984).

6855 **(INIS-mf—9411) Nuclear Liability Act of 8 March 1968 (No. 45) as amended by an Act of 10 May 1974 (No. 249) and by an Act of 22 December 1982 (No. 1275).** (Sweden). Nov 1983. 29p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85780192.

The amendments to this Act fall into two categories. The first category of amendments enabled Sweden to ratify two 1982 Protocols amending the Paris Convention and the Brussels Supplementary Convention respectively. The other amendments raise the nuclear operator's liability from 50 million to 500 million Swedish crowns per incident and introduce a State liability over and above compensation available under the Brussels Convention, thus raising the aggregate amount of compensation to 3,000 million Swedish crowns.

6856 **(NUREG—0090-Vol.7-No.2) Report to Congress on abnormal occurrences. Volume 7, No. 2.** (Nuclear Regulatory Commission, Washington, DC (USA). Office for Analysis and Evaluation of Operational Data). Oct 1984. 42p. NTIS, PC A03/MF A01 - GPO*. File Number TI85900351.

Section 208 of the Energy Reorganization Act of 1974 identifies an abnormal occurrence as an unscheduled incident or event which the Nuclear Regulatory Commission determines to be significant from the standpoint of public health or safety and requires a quarterly report of such events to be made to Congress. The report states that for this report period, there was one abnormal occurrence at the nuclear power plants licensed to operate; the event involved an inoperable containment spray system. There was one abnormal occurrence at the other NRC licensees; the event involved a therapeutic medical misadministration. There were no abnormal occurrences reported by the Agreement States. The report also contains information updating some previously reported abnormal occurrences.

6857 **(NUREG—0304-Vol.9-No.3) Regulatory and technical reports (abstract index journal). Compilation for third quarter 1984, July-September. Volume 9, No. 3.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Technical Information and Document Control). Nov 1984. 145p. NTIS, PC A07/MF A01 - GPO*. File Number TI85900287.

This compilation consists of bibliographic data and abstracts for the formal regulatory and technical reports issued by the US Nuclear Regulatory Commission (NRC) Staff and its contractors. The main citations and abstracts in this compilation are listed in NUREG number order: NUREG-XXXX, NUREG/CP-XXXX, and NUREG/CR-XXXX. These precede the following indexes: Contractor Report Number, Personal Author, Subject, NRC Originating Organization (Staff Reports), NRC Contract Sponsor (Contractor Reports), Contractor, and Licensed Facility.

6858 **(NUREG—0837-Vol.4-No.1) NRC TLD direct radiation monitoring network. Progress report, January-March 1984. Volume 4, No. 1.** Costello, F.; Kramaric, M.; Cohen, L. (Nuclear Regulatory Commission, King of Prussia, PA (USA). Region I). Oct 1984. 148p. NTIS, PC A07 - GPO*. File Number TI85900354.

This report provides the status and results of the NRC Thermoluminescent Dosimeter (TLD) Direct Radiation Monitoring Network. It presents the radiation levels measured in the vicinity of NRC licensed facility sites throughout the country for the first quarter of 1984.

6859 **(NUREG—0857-Suppl.6) Safety Evaluation Report related to the operation of Palo Verde Nuclear Generating Station, Units 1, 2, and 3 (Docket Nos. STN 50-528, STN 50-529, and STN 50-530).** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Oct 1984. 75p. NTIS, PC A04/MF A01 - GPO* $4.50. File Number TI85900358.

Supplement No. 6 to the Safety Evaluation Report for the application filed by Arizona Public Service Company, et al., for licenses to operate the Palo Verde Nuclear Generating Station, Units 1, 2, and 3 (Docket Nos. STN 50-528/529/530), located in Maricopa County, Arizona, has been prepared by the Office of Nuclear Reactor Regulation of the Nuclear Regulatory Commission. The purpose of this supplement is to update the Safety Evaluation Report by providing an evaluation of (1) additional information submitted by the applicant since Supplement No. 5 was issued and (2) matters that the staff had under review when Supplement No. 5 was issued.

6860 **(NUREG—0991-Suppl.3) Safety Evaluation Report related to the operation of Limerick Generating Station, Units 1 and 2 (Docket Nos. 50-352 and 50-353). Supplement 3.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Oct 1984. 154p. NTIS, PC A08/MF A01 - GPO* $5.50. File Number TI85900409.

In August 1983 the staff of the Nuclear Regulatory Commission issued its Safety Evaluation Report (NUREG-0991) regarding the application of the Philadelphia Electric Company (the applicant) for licenses to operate the Limerick Generating Station, Units 1 and 2. Supplement 1 was issued in December 1983 and addressed several outstanding issues. Supplement 1 also contains the comments made by the Advisory Committee on Reactor Safeguards in its report dated October 18, 1983. Supplement 2 was issued in October 1984 and addressed fourteen outstanding and fifty-three confirmatory issues and closed them put. This Supplement 3 addresses the remaining issues that require resolution before issuance of the operating license for Unit 1 and closes them out.

6861 **(NUREG—1048) Safety Evaluation Report related to the operation of Hope Creek Generating Station (Docket No. 50-354).** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Oct 1984. 704p. NTIS, PC A99/MF A01 - GPO* $12.00. File Number TI85900356.

The Safety Evaluation Report for the application filed by Public Service Electric and Gas Company, as applicant, for a license to operate the Hope Creek Generating Station (Docket No. 50-354), has been prepared by the Office of Nuclear Reactor Regulation of the US Nuclear Regulatory Commission. The facility is located in Salem County, New Jersey. Subject to favorable resolution of the items discussed in this report, the NRC staff concludes that the facility can be operated by the applicant without endangering the health and safety of the public.

6862 **(NUREG—1069) Safety Evaluation Report related to the renewal of the operating license for the General Electric-Nuclear Test Reactor (GE-NTR) (Docket No. 50-73).** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Sep 1984. 87p. NTIS, PC A05/MF A01 - GPO* $4.50. File Number TI85900272.

This Safety Evaluation Report for the application filed by the General Electric Company (GE) for a renewal license number R-33 to continue to operate its research reactor has been prepared by the Office of Nuclear Reactor Regulation of the US Nuclear Regulatory Commission. The facility is owned and operated by GE and is located in Pleasanton, California. The staff concludes that the reactor can continue to be operated by GE without endangering the health and safety of the public.

6863 **(NUREG/CR—2000-Vol.3-No.10) Licensee Event Report (LER) compilation for month of October 1984. Volume 3, No. 10.** (Oak Ridge National Lab., TN (USA)). Nov 1984. Contract AC05-84OR21400. 68p. (ORNL/NSIC—200-Vol.3-No.10). NTIS, PC A04/MF A01 - GPO. File Number TI85002871.

This report contains Licensee Event Report (LER) operational information that was processed into the LER data file of the Nuclear Safety Information Center (NSIC) during this one-month period. The LERs are submitted to the Nuclear Regulatory Commission (NRC) by nuclear power plant licensees in accordance with federal regulations. The LER summaries in this report are arranged alphabetically by facility name and then chronologically by event date for each facility. Component, system, keyword, and component vendor indexes follow the summaries.

6864 **(NUREG/CR—3511-Vol.2) Interim reliability evaluation program: analysis of the Calvert Cliffs Unit 1 Nuclear Power Plant. Volume II. Appendices A, B, and C.** Payne, A.C. Jr. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1984. Contract AC04-76DP00789. 781p. (SAND—2086-Vol.2). NTIS, PC A99/MF A01 - GPO. File Number TI85003460.

These 3 appendices comprise the seismic event tree analysis front-line and support system analysis, and accident sequence quantification. (DLC)

6865 **(NUREG/CR—3689-Vol.2) Materials Science and Technology Division Light-Water-Reactor Safety Research Program. Quarterly progress report, April-June 1983. Volume 2.** Shack, W.J. (Argonne National Lab., IL (USA)). Jun 1984. Contract W-31-109-ENG-38. 141p. (ANL—83-85-Vol.2). NTIS, PC A07/MF A01 - GPO. File Number TI84015306.

The progress report summarizes the Argonne National Laboratory work performed during April, May, and June 1983 on water reactor safety problems. The research and development areas covered are Environmentally Assisted Cracking in Light Water Reactors, Transient Fuel Response and Fission Product Release, Clad Properties for Code Verification, and Long-Term Embrittlement of Cast Duplex Stainless Steels in LWR Systems.

6866 **(NUREG/CR—3721/2) Pressure measurements in a hydrogen combustion environment: an evaluation of three pressure transducers. Volume 2.** Marshall, B.W. Jr.; Ratzel, A.C. III. (Sandia National Labs., Albuquerque, NM (USA)). May 1984. Contract AC04-76DP00789. 68p. (SAND—83-2621/2). NTIS, PC A04/MF A01 - GPO. File Number TI85000645.

A series of hydrogen:air combustion tests were performed at the Fully Instrumented Test Site (FITS), located at Sandia National Laboratories in Albuquerque, New Mexico, to evaluate the performance of three strain-gage-type pressure transducers in a combustion environment. The three types of gages were: Precise sensor models 111-1 and 141-1 and Kulite model XT-190. The evaluation was required since these three types of pressure transducers had been used in previous combustion test series at the FITS facility and the results were inconsistent. During this evaluation testing, Brunswick 1101 stainless steel felt metal was used to provide thermal protection for the transducer diaphragms. The objective of this work was to determine experimentally whether such shielding alters the dynamic pressure response of a transducer during a combustion experiment. Results of the sixty tests indicated that the three pressure transducers, when thermally shielded with felt metal, recorded peak combustion pressures that were generally within 5% of the statistical mean for each test.

6867 **(NUREG/CR—3810-Vol.2) Reactor safety research programs. Quarterly report, April-June 1984. Volume 2.** Edler, S.K. (ed.). (Pacific Northwest Lab., Richland, WA (USA)). Nov 1984. Contract AC06-76RL01830. 29p. (PNL—5106-2-Vol.2). NTIS, PC A03/MF A01 - GPO $3.75. File Number TI85003690.

This document summarizes work performed by Pacific Northwest Laboratory from April 1 through June 30, 1984, for the Division of Accident Evaluation and the Division of Engineering Technology, US Nuclear Regulatory Commission. Results from an instrumented fuel assembly irradiation program being performed at Halden, Norway, are reported. Accelerated pellet-cladding interaction modeling is being conducted to predict the probability of fuel rod failure under normal operating conditions. Experimental data and analytical models are being provided to aid in decision making regarding pipe-to-pipe impacts following postulated breaks in high-energy fluid system piping. Fuel assemblies and analytical support are being provided for experimental programs at the Power Burst Facility, Idaho National Engineering Laboratory, Idaho Falls, Idaho. High-temperature materials property tests are being conducted to provide data on severe core damage fuel behavior. Thermal-hydraulic models are being developed to provide better digital codes to compute the behavior of full-scale reactor systems under postulated accident conditions. Severe fuel damage accident tests are being conducted at the NRU reactor, Chalk River, Canada.

6868 **(NUREG/CR—3820) Thermal/hydraulic analysis research program. Quarterly report, April-June 1984. Volume 2 of 4.** (Sandia National Labs., Albuquerque, NM (USA)). Aug 1984. Contract AC04-76DP00789. 55p. (SAND—84-1025/2). NTIS, PC A04/MF A01 - GPO. File Number TI85000029.

The TRAC-PF1/MOD1 independent assessment program at Sandia National Laboratories (SNLA) is part of a multi-faceted effort sponsored by the Nuclear Regulatory Commission (NRC) to determine the ability of various systems codes to predict the detailed thermal/hydraulic response of LWRs during accident and off-normal conditions. This program is a successor to the RELAP5/MOD1 independent assessment project underway at Sandia for the last two years. During this quarter, a sequence of calculations was completed investigating TRAC's ability to model horizontally stratified, cocurrent flow, for comparison with experimental data produced at Northwestern University. TRAC-PF1/MOD1 correctly predicts the qualitative effects of changes in experimental conditions. The results of the completed NEPTUNUS pressurizer component effects test analyses show that somewhat higher pressures and fluid temperatures were calculated during insurges with spray flow than were measured in the test. Sensitivity studies were performed on both the time step used, and the type of components and number of cells used to model the pressurizer test vessel.

6869 **(NUREG/CR—3928) Assessment of reactor coolant pump instrumentation in support of coolant inventory trend analysis.** Arave, A.E. (EG and G Idaho, Inc., Idaho Falls (USA)). Sep 1984. Contract AC07-76ID01570. 45p. (EGG—2333). NTIS, PC A03/MF A01 - GPO. File Number TI85000797.

Reactor coolant pump motor power and temperature measurements are used by Babcock and Wilcox (B & W) plant owners to calculate void fraction for trending ICC conditions while the pumps are running. In this report, the Nuclear Power Plant Instrument Evaluation (NPPIE) project compares system accuracy, capability, and limitations to measurement requirements using small-break test data and full-scale plant analytical studies. Small-break experimental data show that ICC void fraction calculations are conservative compared to gamma densitometer void fraction measurements in the pipe just upstream of the pumps and liquid level conductivity probes in the reactor vessel. Analytical studies verify that a measure of void fraction at the pumps is conservative relative to the desired coolant inventory trend conditions in the reactor vessel.

6870 **(NUREG/CR—3982) Case study of the propagation of a small flaw under PWR loading conditions and comparison with the ASME code design life: comparison of ASME Code sections III and XI.** Yahr, G.T.; Richardson, A.K.; Gwaltney, R.C.; Server, W.L. (Oak Ridge National Lab., TN (USA)). Nov 1984. Contract AC05-84OR21400. 51p. (ORNL—6099). NTIS, PC A04/MF A01 - GPO. File Number TI85002387.

A cooperative study was performed to investigate the degree of conservatism and consistency in the ASME Boiler and Pressure Vessel Code Sect. III fatigue evaluation procedure and Sect. XI flaw acceptance standards. A single, realistic, sample problem was analyzed to determine the significance of certain points of criticism made of an earlier parametric study by staff members of the Division of Engineering Standards of the Nuclear Regulatory Commission. The problem was based on a semielliptical flaw located on the inside surface of the hot-leg piping at the reactor vessel safe-end weld for the Zion 1 pressurized-water reactor (PWR). Two main criteria were used in selecting the problem; first, it should be a straight pipe to minimize the computational expense; second, it should exhibit as high a cumulative usage factor as possible. Although the problem selected has one of the highest cumulative usage factors of any straight pipe in the primary system of PWRs, it is still very low. The Code Sect. III fatigue usage factor was only 0.00046, assuming it was in the as-welded condition, and fatigue crack-growth analyses predicted negligible crack growth during the 40-year design life. When the analyses were extended past the design life, the usage factor was less than 1.0 when the flaw had propagated to failure. The current study shows that the criticism of the earlier report should not detract from the conclusion that if a component experiences a high level of cyclic stress corresponding to a fatigue usage factor near 1.0, very small cracks can propagate to unacceptable sizes.

6871 **(NUREG/CR—4018) SSI sensitivity studies and model improvements for the US NRC seismic safety margins research program.** Johnson, J.J.; Maslenikov, O.R.; Benda, B.J. (Lawrence Livermore National Lab., CA (USA)). Nov 1984. Contract W-7405-ENG-48. 131p. (UCID—20212). NTIS, PC A07/MF A01 - $5.50. File Number TI85003523.

The Seismic Safety Margins Research Program (SSMRP) is a US NRC-funded program conducted by Lawrence Livermore National Laboratory. Its goal is to develop a complete fully coupled analysis procedure for estimating the risk of an earthquake-induced radioactive release from a commercial nuclear power plant. In Phase II of the SSMRP, the methodology was applied to the Zion nuclear power plant. Three topics in the SSI analysis of Zion were investigated and reported here - flexible foundation modeling, structure-to-structure interaction, and basemat uplift. The results of these investigations were incorporated in the SSMRP seismic risk analysis.

6872 **(ORNL/TM—9178) Chemical factors affecting fission product transport in severe LMFBR accidents.** Wichner, R.P.; Jolley, R.L.; Gat, U.; Rodgers, B.R. (Oak Ridge National Lab., TN (USA)). Oct 1984. Contract AC05-84OR21400. 109p. NTIS, PC A06/MF A01; GPO Dep. File Number DE85003787.

This study was performed as a part of a larger evaluation effort on LMFBR accident, source-term estimation. Purpose was to provide basic chemical information regarding fission product, sodium coolant, and structural material interactions required to perform estimation of fission product transport under LMFBR accident conditions. Emphasis was placed on conditions within the reactor vessel; containment vessel conditions are discussed only briefly.

6873 **(PNL-SA—12010) Content validation applied to job simulation and written examinations.** Saari, L.M.; McCutchen, M.A.; White, A.S.; Huenefeld, J.C. (Battelle Human Affairs Research Center, Seattle, WA (USA)). Aug 1984. Contract AC06-76RL01830. 12p. (CONF-8408126—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003644.

From American Phychological Association meeting; Toronto, Canada (24 Aug 1984).

The application of content validation strategies in work settings have become increasingly popular over the last few years, perhaps spurred by an acknowledgment in the courts of content validation as a method for validating employee selection procedures (e.g., Bridgeport Guardians v. Bridgeport Police Dept., 1977). Since criterion-related validation is often difficult to conduct, content validation methods should be investigated as an alternative for determining job related selection procedures. However, there is not yet consensus among scientists and professionals concerning how content validation should be conducted. This may be because there is a lack of clear cut operations for conducting content validation for different types of selection procedures. The purpose of this paper is to discuss two content validation approaches being used for the development of a licensing examination that involves a job simulation exam and a written exam. These represent variations in methods for applying content validation. 12 references.

6874 **(PNL-SA—12428) Handbook for value-impact assessments of NRC regulatory actions.** Mullen, M. (Pacific Northwest Lab., Richland, WA (USA)). Nov 1984. Contract AC06-76RL01830. 6p. (CONF-841105—47). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003643.

From Joint meeting of the American Nuclear Society and the Atomic Industrial Forum; Washington, DC, USA (11 Nov 1984).

According to current Nuclear Regulatory Commission (NRC) procedures, value-impact (cost-benefit) assessments are required for all rulemaking actions and other NRC requirements and guidance submitted for review by the Committee to Review Generic Requirements (CRGR) and for decision by the Executive Director for Operations (EDO) or the Commission. In December 1983, the NRC published A Handbook for Value-Impact Assessment. This Handbook has been incorporated into current NRC procedures as the recommended guideline for preparing value-impact analyses. This paper summarizes the background, objectives, scope, and contents of the Handbook.

6875 **(PNL-SA—12500) Integration of human reliability analysis into the probabilistic risk assessment process: Phase 1.** Bell, B.J.; Vickroy, S.C. (Pacific Northwest Lab., Richland, WA (USA); Battelle Columbus Labs., OH (USA)). Oct 1984. Contract AC06-76RL01830. 17p. (CONF-8410142—37). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85002537.

From 12. water reactor safety research information meeting; Gaithersburg, MD, USA (23 Oct 1984).

A research program was initiated to develop a testable set of analytical procedures for integrating human reliability analysis (HRA) into the probabilistic risk assessment (PRA) process to more adequately assess the overall impact of human performance on risk. In this three-phase program, stand-alone HRA/PRA analytic procedures will be developed and field evaluated to provide improved methods, techniques, and models for applying quantitative and qualitative human error data which systematically integrate HRA principles, techniques, and analyses throughout the entire PRA process. Phase 1 of the program involved analysis of state-of-the-art PRAs to define the structures and processes currently in use in the industry. Phase 2 research will involve developing a new or revised PRA methodology which will enable more efficient regulation of the industry using quantitative or qualitative results of the PRA. Finally, Phase 3 will be to field test those procedures to assure that the results generated by the new methodologies will be usable and acceptable to the NRC. This paper briefly describes the first phase of the program and outlines the second.

6876 **(SAND—84-1341C) Development of ultrasonic thermometry for application in LMFBR safety research.** Field, M.E. (Sandia National Labs., Albuquerque, NM (USA)). 1984. Contract AC04-76DP00789. 7p. (CONF-8411119—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003803.

From IEEE ultrasonics symposium; Dallas, TX, USA (14 Nov 1984).

Results of three recent tests using ultrasonic thermometry for temperature profiling in nuclear reactor accident studies are discussed. Temperatures to near 3000°C have been measured. Multie-

lement sensors of up to 14 measurement zones have been used with less than 15 mm spatial resolution. Ultrasonic thermometry development and sensor fabrication techniques necessary to achieve these results are presented.

6877 **(SAND—84-1652C) Seismic fragility testing of naturally-aged, safety-related, class 1E battery cells.** Bonzon, L.L.; Hente, D.B.; Kukreti, B.M.; Schendel, J.S.; Black, D.A.; Paulsen, G.D.; Tulk, J.D.; Janis, W.J.; Aucoin, B.D. (Sandia National Labs., Albuquerque, NM (USA); Ontario Hydro Research Lab., Toronto (Canada)). 1984. Contract AC04-76DP00789. 29p. (CONF-8410142—4). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85001711.

From 12. water reactor safety research information meeting; Gaithersburg, MD, USA (23 Oct 1984).

The concern over seismic susceptibility of naturally-aged lead-acid batteries used for safety-related emergency power in nuclear power stations was brought about by battery problems that periodically had been reported in Licensee Event Reports (LERs). The Turkey Point Station had reported cracked and buckled plates in several cells in October 1974 (LER 75-5). The Fitzpatrick Station had reported cracked battery cell cases in October 1977 (LER 77-55) and again in September 1979 (LER 79-59). The Browns Ferry Station had reported a cracked cell leaking a small quantity of electrolyte in July 1981 (LER 81-42). The Indian Point Station had reported cracked and leaking cells in both February (LER 82-7) and April 1982 (LER 82-16); both of these LERs indicated the cracked cells were due to expansion (i.e., growth) of the positive plates.

6878 **(SAND—84-1653) Safety program considerations for space nuclear reactor systems.** Cropp, L.O. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1984. Contract AC04-76DP00789. 26p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85003295.

This report discusses the necessity for in-depth safety program planning for space nuclear reactor systems. The objectives of the safety program and a proposed task structure is presented for meeting those objectives. A proposed working relationship between the design and independent safety groups is suggested. Examples of safety-related design philosophies are given.

6879 **(SAND—84-1814C) TRAC-PF1/MOD1 independent assessment at Sandia National Laboratories.** Buxton, L.D.; Kmetyk, L.N.; Dobranich, D.; Byers, R.K.; Peterson, A.C.; Elrick, M.G. (Sandia National Labs., Albuquerque, NM (USA)). 1984. Contract AC04-76DP00789. 12p. (CONF-8410142—20). NTIS, PC A02/MF A01; GPO Dep. File Number DE85000412.

From 12. water reactor safety research information meeting; Gaithersburg, MD, USA (23 Oct 1984).

Most of the results obtained so far in the assessment effort have been in good overall agreement with the available data. We have found no gross errors in predicted behavior which would indicate that the physical models or correlations contained in TRAC-PF1/MOD1 were totally inadequate for the range of parameters of interest in full-scale PWR analyses. The most serious deficiency noted could well be the apparent inability of the code to predict early-time quench behavior during large-break LOCAs. Many of the coding, documentation and modelling inadequacies identified in the course of our assessment calculations are being or have already been addressed by the code developers.

6880 **(SAND—84-2075C) Behavior or hydrogen igniters during operation of water sprays in containment.** Nelson, L.S. (Sandia National Labs., Albuquerque, NM (USA)). 1984. Contract AC04-76DP00789. 18p. (CONF-8410142—19). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85000411.

From 12. water reactor safety research information meeting; Gaithersburg, MD, USA (23 Oct 1984).

The deliberate ignition systems installed in ice condenser PWR and Mark III BWR nuclear plants offer considerable promise for the control of hydrogen resulting from a postulated core uncovery accident. However, a second safety-related system, namely, water sprays intended primarily to reduce steam over-pressure in a similar accident, might interfere with the proper operation of the numerous resistively heated igniters used in the deliberate ignition system. Sandia National Laboratories has been requested to investigate independently how these igniters might behave during the operation of the water spray system in the containment of a nuclear plant. A series of experiments have been run with both resistively heated helical (Tayco Model No. 193-3442-4) and cylindrical (General Motors AC 7G diesel glow plug) igniters. Tests were performed with and without spray shields at various spray fluxes and with and without premixed 6 percent hydrogen/air atmospheres surrounding the igniters. (The spray shields are metal sheets mounted horizontally above the igniters.)

6881 **LMFBR fuel assembly design for HCDA fuel dispersal.** Lacko, R.E.; Tilbrook, R.W. (to Dept. of Energy). US Patent 4,462,958. 31 Jul 1984. Filed date 30 Apr 1982. vp.

PAT-APPL-373469.

A fuel assembly for a liquid metal fast breeder reactor having an upper axial blanket region disposed in a plurality of zones within the fuel assembly. The characterization of a zone is dependent on the height of the axial blanket region with respect to the active fuel region. The net effect of having a plurality of zones is to establish a dispersal flow path for the molten materials resulting during a core meltdown accident. Upward flowing molten material can escape from the core region and/or fuel assembly without solidifying on the surface of fuel rods due to the heat sink represented by blanket region pellets.

6882 **Electrical cable fire test program for nuclear power plants-1984 update.** Chavez, J. (Sandia National Laboratories, Albuquerque, NM). pp 15 of Shaping our energy future. Knoxville, TN, USA; LTM Consultants (1984). (CONF-840229—).

From 11. annual WATTec conference and exposition - shaping our energy future; Knoxville, TN, USA (21 Feb 1984).

Abstract only.

The probability of fires causing significant damage within nuclear power plants has been demonstrated through probabilistic risk assessments and actual occurrences of fires within nuclear power plants. As a result of this, Sandia National Laboratories has been performing confirmatory testing, as well as basic fire protection research, for the U.S. Nuclear Regulatory Commission. This presentation reviews the results of two previous research programs: an investigation of the twenty-foot separation criteria specified in Appendix R to 10 CFR 50 and a cable fire suppression test program. New fire protection research programs to be discussed will include: (1) cable damageability tests which will enable us to determine cable functionality and damage thresholds, (2) equipment cabinet survey and testing to evaluate the susceptibility of cabinets to fires, particularly control room cabinets, and (3) fire characterization of potential fuels in nuclear power plants. The conclusions of the completed programs and the research to date are presented.

6883 **Destabilization of film boiling due to arrival of a pressure shock. Part I. Experimental.** Inoue, A.; Bankoff, S.G. (Northwestern Univ., Evanston, IL). *Journal of Heat Transfer;* **103**: No. 3, 459-464(Aug 1981).

Transient heat transfer from an electrically-heated 3 mm o.d. horizontal tube, initially in subcooled film boiling, was measured immediately after passage of a shock wave of 1 to 5 x $10^5$ N/m$^2$ over-pressure. The fluids tested were Freon-113 and 95 percent ethanol-5 percent water at initially 0.5 to 2 x $10^5$ N/m$^2$ at 22 to 24°C. Transient heat transfer rates, averaged over 0.5 to 1 ms after vapor film collapse, ranged up to 20 times the steady-state value. The maximum transient flux occurred at supercritical contact temperatures, with frequently a minimum in the range of contact temperatures between the homogeneous nucleation and the critical temperature. Photography at 5000 frames/s showed apparently complete vapor film collapse within one or two frames, followed by re-establishment of film boiling in approximately 1 ms, and eventually nucleate boiling in approximately 100 ms. The surface temperature which gave the highest peak transient flux shifted appreciably with increasing shock pressure, which indicates some compressibility even after contact was made. Implications for vapor explosions are discussed.

6884 **Destabilization of film boiling due to arrival of a pressure shock. Part II. Analytical.** Inoue, A.; Ganguli, A.; Bankoff, S.G. (Tokyo Inst. of Tech., O-okayama, Japan). *Journal of Heat Transfer;* **103**: 465-464(Aug 1981).

Part 1 of this work the heat transfer during the first two ms after passage of a shock past a hot nickel tube surrounded by subcooled Freon-113 or ethanol was studied. The following important results were obtained: (1) the peak heat flux exhibits a maximum of a heater surface temperature of 280 to 350°C, depending upon the strength of the shock. This is well above the critical temperature, so that nucleation considerations are irrelevant. (2) The maximum of the peak heat flux envelope depends upon the shock ΔP, indicating that only partial contact is made upon collapse of the vapor film. (3) The collapse is rapid (1 to 2 frame at 5000 f/s), and is produced by relatively weak shocks (ΔP = 2 to 3 atm.). In the present work, the vapor film collapse is studied analytically, in order to obtain additional insight into the mechanism. A Lagrangian transformation due to Hamill and Bankoff is introduced to immobilize the moving boundary, and a polynomial temperature distribution in the transformed mass variable is assumed in the vapor region, as well as in the liquid region. This leads to a set of coupled nonlinear ordinary differential equations in the three regions, which are solved numerically. Two models were developed: (1) a detailed model, taking into account the Knudsen layers at the vapor-liquid and vapor-solid interfaces, and (2) a simplified model, in which these layers were neglected, and a linear temperature profile in the Lagrangian vapor phase variable was assumed. It is found that the initial vapor mass is a key variable determining whether collapse is achieved. In practice, this is a stochastic variable due to bubble departure, which explains the observed heat flux data scatter. The analytical results are in general agreement with the experimental data.

6885 **Fuel-coolant interactions in a shock tube with initially-established film boiling.** Sharon, A.; Bankoff, S.G. (Northwestern Univ., Evanston, IL). *PCH, PhysicoChemical Hydrodynamics;* **2**: No. 2/3, 177-202(1981).

Fuel-coolant interaction studies are described in which a new mode of contact and establishment of film boiling was used. The method employs heating of a liquid metal in a crucible within a shock tube while raising the coolant level to overflow the crucible. A pressure shock wave is then initiated by rupturing a diaphragm in the driver section. Some results with butanol and water coolants are discussed.

6886 **Existence of steady supercritical plane thermal detonations.** Sharon, A.; Bankoff, S.G. (Northwestern Univ., Evanston, IL). *International Journal of Heat and Mass Transfer;* **24**: No. 10, 1561-1572(1981). Contract AC02-76ET37210.

The conditions for existence of strongly supercritical steady detonations, proposed by Board and Hall, are considered. Fragmentation by local boiling is excluded, and only hydrodynamic mechanisms, such as boundary-layer stripping and/or Taylor instability can be operative. Truly steady supercritical detonations are achieved only when the fragmentation zone is terminated by an equilibrium Chapman-Jouguet plane (zero velocity and temperature difference between fuel and coolant).

6887 **(CE-Trans—7802) Collective doses at Biblis nuclear power station.** Schroeder, H.J.; Ambros, R.; Heinze, W. Translated from *Atomkernenergie/Kerntechnik ;* **36**: No. 2, 112-114(1980). 11p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85900116. DE85900116

Radiation monitoring in the nuclear power plant at Biblis includes not only the high-priority monitoring of individual doses but also detailed monitoring of the collective dose for specified periods and activities. The collective dose can be taken as an indicator for the effectiveness of planning, execution and radiation monitoring of jobs. On the basis of experience from 4 inspection periods it was attempted to determine in advance the absolute amount and characteristic with time of the collective dose for the 1979 Unit B inspection. This forecast requires knowledge of the following parameters: empirical data for individual dose-intensive activities, daily base value for the sum of low-dose activities, achievement of a stable state with regard to organization, planning, experience and the plant. 2 references, 4 figures, 2 tables.

# 25 ENERGY STORAGE

## 2501 Magnetic

6888 **(AD-A—144282/1) Pulsed inductive energy store. Final report July 1982-January 1984.** Johnson, D.E.; Barber, J.P. (IAP Research, Inc., Dayton, OH (USA)). May 1984. 67p. NTIS, PC A04/MF A01.

The objective of this program was to evaluate the technical feasibility of coaxial toroidal coils as high current pulsed energy storage inductors. The program included an analytic investigation, and the design, fabrication and testing of a cryogenically cooled coaxial toroidal coil. The most promising concept we investigated was a multiturn sectored inductor constructed by arranging several pancake coils (sectors) so that they approximate a toroid and connecting the coils electrically in parallel.

## 2503 Pumped Hydro

6889 **(CE-Trans—7817) Operating experience with the machines of the Schluchsee underground power station.** Doering, K. (Central Electricity Generating Board, London (UK); Association des Ingenieurs Electriciens, Liege (Belgium)). 1982. Translation source information not available . 21p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85900005.

The following report deals mainly with operating experience resulting from the use of the hydraulic machines, disregarding normal start-up problems. The focus of attention highlights three main areas: efficiencies, rapidity of change in modes of operation, hydraulic short circuit and non-availabilities. General construction problems such as high loads and durability, are treated marginally.

## 2505 Flywheels

*REFER ALSO TO CITATION(S) 2505006463*

## 2506 Thermal

*REFER ALSO TO CITATION(S) 2506006658*

6890 **(DOE/ID/12427—T1) Direct contact heat recovery from molten salt. Final report.** (Thermal Energy Storage, Inc., San Diego, CA (USA)). 1984. Contract AC07-83ID12427. 129p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE85002830.

The research in this project addresses technological deficiencies associated with efficient and economical retrieval of heat energy from molten salt systems. In this work, the large latent heat of fusion stored in molten salt hydrates and other candidate phase change materials (PCM) is removed by internal boiling of a volatile heat transfer fluid (HTF). This novel procedure eliminates the conventional use of submerged heat exchangers which are costly and, in crystallizing salts, ineffective. The objective of this work is to investigate and define the thermochemical conditions and material properties that are critical for application of this concept in environments that yield significant energy savings.

6891 **(PB—84-232461) Dynamic modelling and numerical treatment of a packed bed heat store.** Golshekan, M. (Open Univ., Milton Keynes (UK). Energy Research Group). Apr 1984. 88p. (ERG—047). NTIS, PC E05/MF E05.

Energy storage can be an important aspect of a variety of energy supply systems. In this work the main concern is with energy storage in the form of sensible heat in a packed bed, but first this type of storage is placed in context, via a brief description of the main ways in which thermal energy is stored. The approach is to develop a computer model and to verify it against laboratory measurements on a packed-bed. Various models are described and are compared with the one developed here, using packed-bed data from other authors and reasonable values of unknown parameters.

Future work is indicated, and will include further development of the model, and its verification. An outline is given of an improved design of a laboratory-based packed-bed.

6892 **(BG-Trans—5869) Experiments on the ADAM 1 plant for the optimization of methanization process in the Long Distance Nuclear Energy Transmission System test run performed in the Spring of 1980.** Hoehlein, B.; Menzer, R.; Vorwerk, M.; Skov, A. (British Gas Corp., London; Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorbauelemente). 15 Sep 1982. Translation of Juel-Spez-91, October 1980. 44p. NTIS (US Sales Only), PC A03. File Number DE84901726.

This report has been prepared within the scope of the collaboration contract in the field of long distance nuclear energy transmission between the Kernforschungsanlage Juelich GmbH and the Rheinische Braunkohlenwerke AG for the development of processes in the field of heat transmission by means of chemically bonded energy by the Methane Reforming- Methanization System with the assistance from the Federal German Republic. The partners of the NFE project (Nukleare Fernenergie) - Kernforschungsanlage Juelich GmbH und Rheinische Braunkohlenwerke AG - have investigated various problems of the methanation of synthesis gas in order to improve the Long Distance Nuclear Energy System. In a test run with the pilot plant ADAM 1 - February 1980 - the partners of the NFE project, in collaboration with Haldor Topsoe A/S, could obtain important results with regard to the high temperature methanation up to 700°C, to a closed steam reforming - methanation circuit and to the operation of a recycle ejector in ADAM 1 to limit the outlet temperature of the first reactor.

## 2508 Chemical

*REFER ALSO TO CITATION(S) 2508006655*

## 2509 Batteries

6893 **(AD-A—144243/3) Evaluation of aircraft battery charge, discharge, and analyzation requirements for ground support equipment. Final report April 1982-November 1983.** O'Haver, T.E. (Naval Weapons Support Center, Crane, IN (USA). Weapons Quality Engineering Center). 27 Jul 1984. 93p. (WQEC/C—83-423). NTIS, PC A05/MF A01.

This report provides an up-to-date listing of all aircraft batteries that are presently being used as well as those that will be used in the future. Test results and associated recommendations pertaining to the servicing requirements and associated charge, discharge, and analyzation equipment are delineated. Vented lead acid battery charging equipment performs satisfactorily and should continue to be utilized until these batteries are phased out by sealed lead acid batteries.

6894 **(AD-A—144252/4) Solid state batteries, literature survey, analysis of pertinent results and prospective for further research. Final report January-December 1983.** Balkanski, M.; Hammerberg, J. (Paris-6 Univ., 75 (France)). Dec 1983. 66p. NTIS, PC A04/MF A01.

This report contains a literature survey on Solid State Batteries up to December 1983. The main emphasis is on solid state electrolytes. A prospective discussion is carried on Interfacial properties, Thin Films and Size Effects.

6895 **(DOE/SF/10501—015) Lead acid battery cells for substation, generation, telecommunication and related facilities.** (Southern California Edison Co., Rosemead (USA)). 15 Sep 1978. Contract FC03-77SF10501. 30p. (STMPO—492). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85001378.

This paper covers specifications for lead acid battery cells. The specifications are subjected to substations, generation, telecommunications, and related facilities. The paper is divided into the following sections: general terms and conditions, supplemental requirements, technical requirements and proposal requirements.

6896 **(EPRI-EM—3707) 500-kW lead-acid battery for peak-shaving energy storage testing and evaluation.** McClellan, R.N.; Deshpande, S.L. (GNB Batteries, Inc., Langhorne, PA (USA). Industrial Battery Div.). Oct 1984. 57p. Research Reports Center, Box 50490, Palo Alto, CA 94303 $10.00. File Number TI85920086.

This report details the design, fabrication, and installation of a 500-kW, 500-kWh battery for evaluation at the Battery Energy Storage Test (BEST) facility in Hillsborough, New Jersey. The battery was manufactured by GNB Batteries under contract to EPRI and will be used to demonstrate the viability of lead-acid batteries in peak-shaving and load-leveling applications. GNB adapted an off-the-shelf, 160X type of commercial motive power cell of a large enough capacity to meet the requirements necessary for load-leveling in this application. Modifications to the commercial cell design included a new jar, cover, and the inclusion of auxiliary electrolyte agitation and monitoring devices on each cell. GNB selected a series-parallel configuration for the one-hour-rate battery, comprising three strings connected in parallel, with each string having 18 modules connected in series. Each module has six cells connected in series. Each cell has a nominal capacity of 2080 Ah at the six-hour rate, when new, or 1120 Ah at the one-hour rate. Thus, each string with 108 cells in series has a nominal voltage of 216 V and a one-hour capacity of 1120 Ah. The 54 modules may also be connected in series.

6897 **(LBL—18413) Semiconductor electrochemistry approach to the study of oxide films on nickel electrodes. Final report.** Madou, M.J.; Wing, S.; McKubre, M.C.H. (Stanford Research Inst., Menlo Park, CA (USA). Engineering Sciences Lab.). Sep 1984. Contract AC03-76SF00098. 77p. NTIS, PC A05/MF A01; GPO Dep. File Number DE85003042.

Impedance measurements and photoeffect studies on nickel electrodes were carried out to characterize the oxide films on such electrodes. These measurements revealed some interesting fundamental aspects of NiO electrode behavior. We found that, depending on the electrode potential, an n-type or p-type semiconducting oxide can be present at the surface of a nickel electrode, giving rise, respectively, to anodic or cathodic photocurrents under illumination. Impedance measurements show that a solid-state diffusion process, presumably of protons through the oxide film, dominates the impedance behavior for the charged electrode; for the discharged electrode, the impedance behavior is dominated by the space charge inside the p-type oxide. We demonstrated that by using semiconductor electrochemistry techniques new fundamental insights about the kinetics of battery electrodes can be obtained (for example, a diagram for the interfacial energetics of a Ni/NiO electrode was derived from the above measurements). The emphasis in this project more recently has been the elucidation of the role of additives to both electrode and electrolyte on the charge/discharge kinetics. Semiconductor electrochemistry type techniques (such as photocurrent measurements, Mott-Schottky measurements, etc.), as well as cyclic voltammetry, have been used extensively to that end. All the additives tested are impurities of importance that influence battery performance; some for the better, most for the worse.

6898 **(PB—84-234921) Energy conservation by energy storage. Advanced batteries and fuel cells.** Ehringer, H.; Zegers, P.; Hoyaux, G. (Commission of the European Communities, Luxembourg). 1983. 183p. (EUR—8660-EN). NTIS, PC E08/MF E08.

Proceedings of the Third Contractors Meeting held in Talence, France on 25 and 26 April 1983.

The progress of this battery and fuel-cell work was discussed at the Third Contractors' Meeting on 25 and 26 April 1983. The proceedings contain the papers presented during this meeting. Advanced batteries form the major part of this program and the objective is here to develop batteries with an energy and power density of 150 Wh/kg and 100 W/kg respectively. Work on fuel cells is limited. A porous matrix for the liquid electrolyte of a $H_2$/air alkaline fuel cell is being developed. Also papers on future R and D requirements for batteries and fuel cells have been presented.

6899 **Size and weight graded multi-ply laminar electrodes.** Liu, C.T.; Demczyk, B.G. (to Dept. of Energy). US Patent 4,444,852. 24 Apr 1984. Filed date 18 Nov 1982. vp. PAT-APPL-442706.

An electrode is made comprising a porous backing sheet, and attached thereto a catalytically active layer having an electrolyte permeable side and a backing layer contacting side, where the active layer comprises a homogeneous mixture of active hydrophobic and hydrophilic agglomerates with catalyst disposed equally throughtout the active layer, and where the agglomerate size increases from the electrolyte permeable side to the backing sheet contacting side.

# 29 ENERGY PLANNING AND POLICY

6900 **(ANL/CNSV-TM—149) State energy information networks.** Tatar, J.; Ettinger, G.; Wrabel, M. (Argonne National Lab., IL (USA)). Jun 1984. Contract W-31-109-ENG-38. 64p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85003723.

In November 1983, Argonne National Laboratory (ANL) initiated a study under the sponsorship of the US Department of Energy (DOE) State Programs Branch to examine state energy information networks. Goal was to help DOE decide how best to allocate resources to assist states in acquiring information related to state energy programs and policies.

6901 **(ANL/EES-TM—269) Role of the multiprogram laboratories of the Department of Energy in context with federal energy R and D policy.** Asbury, J.G. (Argonne National Lab., IL (USA)). Apr 1984. Contract W-31-109-ENG-38. 22p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004571.

This report tries to delineate appropriate roles for the DOE multiprogram laboratories. The discussion is concerned mainly with the roles of the laboratories in general science and energy-related R and D areas. Section 2 briefly reviews the laboratories' history and the scope of their energy R and D programs. Section 3 describes recent changes in federal R and D policy, examines the causes of the changes, and traces the evolution of the laboratories in the policy context. In Section 4, the role of the multiprogram laboratories is divided into four generic types of activities. This section delineates the kinds of federally supported research that are likely to be performed more efficiently by the laboratories than by universities or industry. Several issues, important to the future effectiveness of the laboratories in meeting industry's R and D needs, are identified and discussed.

## 2901 Energy Analysis And Modeling

*REFER ALSO TO CITATION(S) 2901006908, 6953*

6902 **(IKE—4-116) Elements of game theory in decision making in energy policy.** Lutz, B. (Stuttgart Univ. (Germany, F.R.). Inst. fuer Kernenergetik und Energiesysteme; Stuttgart Univ. (Germany, F.R.). Fakultaet 5 - Energietechnik). Jul 1984. 181p. (In German). NTIS (US Sales Only), PC A09/MF A01. File Number DE85750566.

After a brief survey of some basic game and utility theoretical terms necessary for the comprehension of this paper, the software developments used to deal with the given problems are being introduced. Integrated into the software system RSYST-III they form problem independent, modular basic units for any subsequent problem specific evaluation. As an example of the applicability serves the conflict of interest between the administration and economic unions in the coal sector. The statement of the problem allows for two separate model conceptions. While one may be solved in a strictly game theoretical manner, the other necessitates a more heuristic approach. Sensitivity analyses on the process of utility formation linked with statistical evaluations finally yield the optimal solutions. The interpretation of the results show that plausible instructions as an aid or basis for oncoming decisions can be offered to the decision maker in all cases.

6903 **Sensitivity theory and its application to a large energy-economics model.** Alsmiller, R.G. Jr.; Barish, J.; Drischler, J.D.; Horwedel, J.E.; Lucius, J.L.; McAdoo, J.W. (Oak Ridge National Lab., TN). *Operations Research;* 31: No. 5, 915-937(Sep-Oct 1983). Contract W-7405-ENG-26.

A nonlinear equation theory of sensitivity analysis is discussed and its applicability to a large energy-economics model is demonstrated by applying it to a specific calculation carried out with the Long-Term Energy Analysis Program (LEAP). Numerical results are presented for calculating derivatives of two results of interest with respect to several values of the underlying data elements for which the derivatives are appreciable. In a number of cases, the accuracy of the derivative information obtained has been verified by direct calculations and these comparisons are also presented. The theory used here is, in principle, applicable to a variety of models. It is most useful when applied to models that contain a very large number of data elements.

## 2902 Economics And Sociology

*REFER ALSO TO CITATION(S) 2902006757, 6915, 6949, 6953, 7418, 7419*

6904 **(IIASA-RR—83-9) Fueling Europe in the future. The long-term energy problem in the EC Countries: alternative R and D strategies.** Sassin, W.; Hoelzl, A.; Rogner, H.H.; Schrattenholzer, L. (International Inst. for Applied Systems Analysis, Laxenburg (Austria)). Mar 1983. 104p. (EUR—8421-EN). International Inst. for Applied Systems Analysis, Laxenburg, Austria.

The linkage between the energy problem and the national RandD strategies of the EC countries is investigated in the light of the results of IIASA's (International Institute for Applied Systems Analysis) long-term global energy study, documented in Energy in a Finite World (1981). By considering what may be feasible over the next fifty years in other industrialized world regions, substantial discordance is revealed between the desires of the EC countries for economic growth, energy conservation, and energy imports, and the need for a global balance between energy demand and supply. A way of gradually harmonizing regional energy strategies with the constraints on resources and technologies identified in the IIASA global scenarios has been developed. The two alternative scenarios developed are based on a macroeconomically optimal allocation of capital, manpower, and energy. Given the limited oil imports of the EC in IIASA's global projections, two limiting scenarios are presented to indicate the narrow technological choice in a medium- to long-term future for the EC countries of low economic growth. The two scenarios have either coal or nuclear power as the favoured energy option, supplemented by the other source. (12 refs.)

6905 **(NP—5770080) Pricing regulations in a free enterprise.** Putzke, C. (Erlangen-Nuernberg Univ., Erlangen (Germany, F.R.). Wirtschafts- und Sozialwissenschaftliche Fakultaet). 10 May 1983. 234p. (In German). NTIS (US Sales Only), PC A11/MF A01. File Number DE85770080.

This work is aimed to describe a pricing process as it takes place under the aspect of the dualism of state and economy. So, neither the price that results from purely economic principles nor the price laid down by sovereign device is the sole object of this investigation. Rather, this study deals with a sphere where the economic and the juridical argumentation are normally interwoven. This leads to the consequence that, however necessary a juridical interpretation of an individual set of facts may be, an economic evaluation must, above all, play a central part. This investigation cannot consider all the prices that are in some way subject to a pricing policy. The field of interest is therefore restricted in a way to exclude such prices that are influenced by monetary policy or decisively determined by taxes, protective duties and the like. Its concern is with that part of trade where the government takes care of the pricing of privately produced goods and services. The method adopted consists in investigating first of all the essential basic factors of pricing and the law of prices on a general level in order to proceed to the special sectors of electricity economy and goods transport by road, where the pricing is then examined in detail.

6906 **(NP—5900007) Energy price changes and the induced revaluation of durable capital in US manufacturing.** Berndt, E.R.; Wood, D.O. (Massachusetts Inst. of Tech., Cambridge (USA). Alfred P. Sloan School of Management). Jul 1983. 94p. Massachusetts Inst. of Tech., 50 Memorial Drive, Cambridge, MA 02139. File Number TI85900007.

The modern theory of cost and production is linked with the quality or hedonic literature. According to this quality-quantity demand framework, if quality is important it must be evident in cost-minimizing factor quantity demand equations. As a corollary, input quality can be inferred indirectly using data on, among other things, input quantity. In this sense the existence of energy price-related capital quality is shown to be a testable empirical issue formulated within the modern theory of cost and production. An empirically implementable quality-quantity factor demand model is developed and specified in which the stock and quality of capital is fixed in the short run, capital quality depends on energy prices and the energy efficiency embodied in the surviving vintages of capital, and firms minimize variable costs in producing a given level of output. Data construction procedures and sources are outlined and a measure of the energy efficiency embodied in the capital stock quantity at time t is developed that depends on the vintage structure of capital and the relative energy prices existing when earlier vintages of capital were originally purchased. After discussing other data and econometric issues, empirical results for US manufacturing, 1947-77 are presented. Alternative estimates of quality-adjusted capital stocks are included and these measures are compared with those based on traditional energy price-independent capital stock measurement procedures. Implications of these quality-adjusted capital stock measures for the magnitude of the alleged post-1973 productivity slowdown in US manufacturing are discussed.

6907 **(NP—5900202) Electricity pricing for large supply systems.** Horsley, A. (London School of Economics and Political Science (UK). International Centre for Economics and Related Disciplines). 1984. 39p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85900202.

This is one of a series of discussion papers produced for the Workshop in Theoretical Economics at the International Centre for Economics and Related Disciplines (ICERD). The Centre was established at the London School of Economics in 1978 under the sponsorship of the Suntory-Toyota Foundation.

6908 **(P—300-84-014) Relative cost of electricity production.** Ringer, M. (California Energy Resources Conservation and Development Commission, Sacramento (USA)). Jul 1984. 31p. California Energy Commission, 1516 Ninth St., Sacramento, CA 95814. File Number TI85900188.

The report, Relative Cost of Electricity Production, presents CEC staff estimates of the levelized cost of electricity over the period 1990 to 2020 on a generic basis for 25 different technology-fuel combinations. The technologies for which costs are presented are those which will be commercially available and could begin operation by 1990. The cost of generation is calculated assuming that either a public or investor-owned utility constructs, owns, and operates the power plant. All costs are given in both nominal (includes inflation effects) and real (excludes inflation) terms. The report also summarizes the economic and technical assumptions upon which the relative cost estimates are based.

6909 **Geographical transmission of economic events.** Jones, D.W. (Oak Ridge National Lab., TN). *Economic Geography;* **60**: No. 2, 132-149(Apr 1984).

A two-region monetary economy is modeled as a five-equation system. Exogenous events in either region (changes in union wages, labor productivity, and banking policy) or at the national level (money supply changes) cause changes in price levels, wages, employment, and money stocks in both regions. The model structure permits explicit examination of transmission processes. 8 references, 1 figure, 18 tables.

6910 **Proposed fiscal year 1985 budget request. Hearings before the Committee on Energy and Natural Resources, United States Senate, Ninety-Eighth Congress, Second Session, February 7, 8 and 9, 1984.** Washington, DC, USA; Government Printing Office (1984). 1226p.

Interior Secretary Clark, Energy Secretary Hodel, and representatives of the Federal Energy Regulatory Commission, the Synthetic Fuels Corporation, and the Forest Service testified at three days of hearings on the President's budget proposal for fiscal year 1985. The hearings were part of the preparation for a March 15 report to the Senate Budget Committee. The Department of the Interior's request for $6.49 billion is $100 million below the 1984 level, which Clark attributes to a review of policy, personnel, and process (decision making and operation). The DOE budget request is $15.1 billion, which includes $1.9 billion to acquire oil and transport it to the Strategic Petroleum Reserve. The hearing record includes the testimony and seven appendices with additional comments and responses submitted for the record.

6911 **Social change and risk: implications of the extension of communications and opportunities to the American people.** Carnes, S.A. (Oak Ridge National Laboratory Oak Ridge, TN). pp 48 of Shaping our energy future. Knoxville, TN, USA; LTM Consultants (1984). (CONF-840229—).

From 11. annual WATTec conference and exposition - shaping our energy future; Knoxville, TN, USA (21 Feb 1984).

Abstract only.

In the not so distant past, American society was fairly well ordered, and life was more or less predictable. Patterns of authority were discernible in the family, in business and in government; markets behaved within understood limits; and life cycles, from birth to death, followed well established patterns. There were, to be sure, significant discontinuities that threatened such order-wars, depressions, and changes in the technological paraphanalia of our society-but these problems and our approaches to them were seen as corroborative of dominant values rather than as challenges to them. More recently we have experienced a substantial shift in the locus of our relationships to one another and to the world. In response to a variety of technological and social factors, we increasingly are confronted with counteracting tendencies between the privatization and socialization of our lives, our concerns and our conflicts, and a corresponding tension between tendencies toward centralization and decentralization of society and authority. These confrontations and some of their consequences and implications are particularly noteworthy with regard to two fundamental changes in recent American experience-changes in the pattern of information dissemination and communication and the extension of opportunities to, or the demands for opportunities from, minorities and women. These revolutions have without doubt called into question our conventional wisdom regarding lifestyle and have arguably restructured society. Whether they, and other social changes, pose a similar risk to survival depends in large part on how the consequences of these changes are incorporated into traditional approaches to collective decisionmaking in the United States.

## 2903 Environment, Health, And Safety

*REFER ALSO TO CITATION(S) 2903007375, 7377, 7385, 7414, 7876, 7877*

6912 **(TVA/PUB—84/79) TVA's responsibilities and role in the identification, protection, and use of cultural resources.** Burbank, J.H. (Tennessee Valley Authority, Knoxville (USA). Div. of Land and Economic Resources). 29 Jun 1984. 26p. NTIS, PC A03/F A01. File Number DE85900237.

This report discusses cultural resources legislation as it applies to the activities of TVA. (ACR)

6913 **Oak Ridge environmental problems: lessons learned.** Bibb, W.R. (Department of Energy, Oak Ridge, TN). pp 30 of Shaping our energy future. Knoxville, TN, USA; LTM Consultants (1984). (CONF-840229—).

From 11. annual WATTec conference and exposition - shaping our energy future; Knoxville, TN, USA (21 Feb 1984).

Abstract only.

This presentation is a short review of recent environmental problems affecting DOE, Oak Ridge Facilities. The lessons which have been learned from this experience are discussed.

## 2904 Natural Resources

*REFER ALSO TO CITATION(S) 2904007375*

6914 **(NP—5770094) Annual report on the raw material situation 1982/83.** (Bundesanstalt fuer Geowissenschaften und Rohstoffe, Hannover (Germany, F.R.)). Feb 1984. 56p. (In German). NTIS (US Sales Only), PC A04. File Number DE85770094.

The raw material supply of the Federal Republic of Germany in 1982 is discussed by means of the domestic production, the imports and the price development. The raw materials are grouped into the energy raw materials, non-metallic raw materials and metal raw materials. The financial contribution of the exploration activities of the Federal Government is presented in tables. The imports and exports of mineral raw materials into and out of the Federal Republic of Germany are presented according to countries and amounts for 1982.

6915 **(TVA/PUB—85/1) Environment and TVA: toward a regional plan for the Tennessee Valley, 1930s.** Schaffer, D. (Tennessee Valley Authority, Norris (USA). Cultural Resources Program). 1985. 35p. NTIS, PC A03/MF A01. File Number DE85900360.

The paper presents a historical survey of the Tennessee Valley Region, stressing its demographic and economic aspects, and discusses the role of the Tennessee Valley Authority in the rehabilitation and development of the region. 59 references. (ACR)

6916 **Critical materials supply.** Zucker, A. (Oak Ridge National Laboratory, Oak Ridge, TN). pp 40 of Shaping our energy future. Knoxville, TN, USA; LTM Consultants (1984). (CONF-840229—).

From 11. annual WATTec conference and exposition - shaping our energy future; Knoxville, TN, USA (21 Feb 1984).

Abstract only.

By projecting global population growth and demand for nonrenewable materials over the next century, it appears unlikely that the world will run short of any element before about 2050. This, then, provides considerable time to develop new technology to economically exploit lower grade and alternative ores to bring some 30 elements into essentially infinite supply, and to develop substitutes, using these 30 elements, to satisfy the requirements of modern civilized societies with attractive living standards.

## 2905 Research, Development, Demonstration, And Commercialization

*REFER ALSO TO CITATION(S) 2905006382, 6413, 6463, 6748, 7612, 8072*

6917 **(DOE/ER/30059—T1) Needs, opportunities, and options for large scale systems research.** Thompson, G.L. (Carnegie-Mellon Univ., Pittsburgh, PA (USA). Graduate School of Industrial Administration). Oct 1984. Contract AC01-84ER30059. 65p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85002664.

The primary purpose of the 1984 Conference on Large Scale Systems Research was to determine several high-risk, long-range research areas which, if successfully pursued, would have significant impact on the design and operation of future systems and the redesign and operation of current systems. One of the things that became evident in the conference was that the arbitrary division of the study of systems into separate parts such as, system modelling, mathematical solution, computer solution, and managerial implementation is not necessarily productive because each part has a significant interaction with each other part. Some researchers can, will, and should concentrate on narrowly-focussed technical problems in a single area. But in order to create feedback loops connecting the various areas, other kinds of more global research, perhaps done by research teams, which combine expertise from several areas is also needed. When possible such teams should include members from academic and industrial organizations, and/or governmental laboratories. In Section 1.1 the principal recommendations of the panel members are listed with justifications and estimates of time needed and costs. Section 1.2 gives an analysis of the questionnaire responses received from 20 respondees. Chapters 2-4 give background information which will help in the understanding of the recommendations given here. The complete questionnaire results are given in the Appendix.

6918 **(DOE/METC—85-6) Technology Transfer Program: FY 84.** Sink, C.H. (USDOE Morgantown Energy Technology Center, WV). Oct 1984. 67p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85001959.

The Morgantown Energy Technology Center (METC) Technology Transfer Program is envisioned as the last step in the fossil energy research and development (R & D) process. The intent of this Technology Transfer Program is to make the information on METC fossil energy technologies available to appropriate users for their consideration, adoption, and use. The concept on which this Technology Transfer Program is based centers around the lead laboratory R & D mission areas. The 13 fossil energy technology areas for which METC is responsible supply the technical information dissemination base for which the various technology transfer mechanisms function as information dissemination channels to users. Technology transfer is therefore the way of doing business for this Energy Technology Center. The 13 METC fossil energy R & D lead mission technologies are: coal gasification, fluidized-bed combustion, gas stream cleanup, heat engines, fuel cells, components, instrumentation and control, low-rank coals, unconventional gas recovery, oil shale, tar sands, underground coal gasification, and Arctic and offshore technologies.

6919 **(EPRI-NP—3721-SR) Proceedings: technology transfer seminars, Palo Alto, California, April-September 1983.** (COE Corp., Mountain View, CA (USA)). Oct 1984. 148p. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $16.00. File Number TI85920117.

The goal of this report is to provide information that may be useful to others that must confront the many complex issues included in the broad and often ill-defined phrase technology transfer. Seven topics that address various aspects of the technology transfer process are included. Two address the general framework of the process, two discuss business aspects, while the remaining three examine the process of three R & D projects funded by EPRI.

6920 **(NMAB—418) High-technology ceramics in Japan.** (National Research Council, Washington, DC (USA). Commission on Engineering and Technical Systems). 1984. 70p. National Research Council, 2101 Constitution Ave., Washington, DC 20418. File Number TI85900389.

High-technology ceramics are made from extremely pure, composition-controlled, ultra-minute particles formed, sintered, and treated under closely regulated conditions. These properties and processes give superior performance characteristics that allow the materials to be used in a wide range of demanding applications far beyond the capabilities of conventional ceramics. Japan is widely viewed as having a significant national commitment to developing and exploiting high-technology ceramics in order to advance its domestic and international markets. This situation contrasts markedly with that in the United States, where such an intensive effort has not been mounted. This report presents the findings of a committee formed to assess the situation in Japan, with the objective of providing an understanding of the possible effects on high-technology ceramics in the United States. Another important objective was to establish a basis for possible future cooperation in ceramics science and technology between Japan and the United States. The committee concluded that there is, indeed, a strong commitment in Japan to the rapid development and exploitation of high-technology ceramics. The greatest potential for application of this technology appears to be in the automobile and electronics industries. Cooperation between Japan and the United States would be feasible and welcome, especially in the development of common standards, the exchange of nonproprietary information, and possibly cooperative projects. The committee recommends several steps that should be taken in the United States to advance the field of high-technology ceramics, particularly in view of the effort now taking place in Japan.

6921 **(NP—5770074) GBF scientific progress report 1983.** (Gesellschaft fuer Biotechnologische Forschung m.b.H., Braunschweig (Germany, F.R.)). 1984. 197p. (In German). NTIS (US Sales Only), PC A09/MF A01. File Number DE85770074.

The scientific results are classified according to the 1983 research programme's essential focal points and projects of GBF. These focal points are characterised by: bio-synthesis products from micro-organisms, medically important products gained from animal cells, natural substances from animal cells, enzymatic conversions and enzyme engineering and bio-engineering. Two reports are abstracted individually.

6922 **(NP—5770081) Financial aids in the sectors energy conservation, rational energy utilization, new energy technologies.** (Bayerisches Staatsministerium fuer Wirtschaft und Verkehr, Muenchen (Germany, F.R.)). 1983. 54p. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE85770081.

'Energy conservation, rational energy production and utilization and a wider use of new technologies are a pressing need. Rational and economical use of energy are on principle to be achieved via the markes, too. The part of the state in this task is to assist and support control by the market with measures that are as far as possible in agreement with the market, especially enlightenment and financial aid.' These are essential basic contents of the energy programme of the governments of the Land Bavaria. As regards promotion, the same is true of the energy sector as of most other sectors of promotion. Demand exceeds supply, not all requests for promotion can be complied with. Therefore and on account of the increasing scarcity of the means available, promotion should be aimed and should be limited to where it is urgently required and will be most effective. The present compilation on financial aids is intended to show the possibilities for promotion that exist in these sectors at the level of the EC, the federal level and the level of the Land, the requirements to become eligible and the procedure to apply for resepctively obtain the means.

## 2906 Nuclear Energy

*REFER ALSO TO CITATION(S) 2906006748, 6782, 6948, 8072*

6923 **(DOE/NE—0048/7) Update: nuclear power program information and data, April-June 1984.** (USDOE Assistant Secretary for Nuclear Energy, Washington, DC. Office of Converter Reactor Deployment). Sep 1984. 87p. (PB—84-911502). NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85000837.

UPDATE is published by the Office of Converter Reactor Deployment, Office of Nuclear Energy, to provide a quick reference source on the current status of nuclear powerplant construction and operation in the United States and for information on the fuel cycle, economics, and performance of nuclear generating units. Similar information on other means of electric generation as related to nuclear power is included when appropriate. UPDATE is intended to provide a timely source of current statistics, results of analyses, and programmatic information proceeding from the activities of the Office of Nuclear Energy and other components of the Department of Energy, as well as condensations of topical articles from other sources of interest to the nuclear community.

6924 **(INIS-mf—9086) Report of the Committee Existing Nuclear Power Plants.** (Ministerie van Economische Zaken, The Hague (Netherlands). Commissie Bestaande Kerncentrales). 12 Jan 1983. 150p. (In Dutch). NTIS (US Sales Only), PC A08/MF A01. File Number DE85780145.

This report embodies the findings of the Committee 'Existing Nuclear Power Plants' of the Dutch Department of Economic Affairs. The terms of reference comprised an actual analysis of several aspects of the Netherlands' nuclear power. Two options are studied: (1) permanent and (2) temporary shutdown of the existing plants. As a substitute, only electric power generation using coal is considered. Subsequently, the committee deals with legal aspects; financial-economical aspects; employment, energy policy, security risks; environmental aspects; international and political aspects.

6925 (INIS-mf—9091, pp 9-12) **Role of the Czechoslovak AEC in securing the information services for the Czechoslovak nuclear programme.** Panchatek, O. (Ceskoslovenska Komise pro Atomovou Energii, Prague). 1982. (In Czech). NTIS (US Sales Only), PC A08/MF A01. File Number TI85780139. (CONF-821288—).

From National seminar on the system of scientific and technical information for the Czechoslovak nuclear programme; Jihlava, Czechoslovakia (7 Dec 1982).

The orientation is described of the activities of the Czechoslovak Atomic Energy Commission in the field of scientific and technical information. Also described is Czechoslovakia's contribution to the development and use of INIS.

6926 (INIS-mf—9091, pp 63-67) **Data information systems and their use by the branch information centre.** Hajicek, J. (Ceskoslovenska Komise pro Atomovou Energii, Zbraslav nad Vltavou. Ustredni Informacni Stredisko pro Jaderny Program). 1982. (In Czech). NTIS (US Sales Only), PC A08/MF A01. File Number TI85780139. (CONF-821288—).

From National seminar on the system of scientific and technical information for the Czechoslovak nuclear programme; Jihlava, Czechoslovakia (7 Dec 1982).

A survey is presented of the current state of data information systems in the Nuclear Information Centre. The Centre uses and contributes to the development of the Energy and Economic Data Bank, Nuclear Power Experience, the joint data information system of the Nuclear Information Centre and CNII Atominform.

6927 (INIS-mf—9091, pp 159-163) **System of processing data information from the nuclear field at Energoprojekt Prague.** Matejkova, E. (Energoprojekt, Prague (Czechoslovakia)). 1982. (In Czech). NTIS (US Sales Only), PC A08/MF A01. File Number TI85780139. (CONF-821288—).

From National seminar on the system of scientific and technical information for the Czechoslovak nuclear programme; Jihlava, Czechoslovakia (7 Dec 1982).

The work is described of the branch information system operated by Energoprojekt and the method of processing and sorting data relevant for the power generation branch. Processing is not automated and is oriented to a narrow circle of users.

6928 (INIS-mf—9091, pp 13-16) **International cooperation in scientific and technical information with regard to nuclear science and technology.** Patek, O. (Ceskoslovenska Komise pro Atomovou Energii, Zbraslav nad Vltavou. Ustredni Informacni Stredisko pro Jaderny Program). 1982. (In Czech). NTIS (US Sales Only), PC A08/MF A01. File Number TI85780139. (CONF-821288—).

From National seminar on the system of scientific and technical information for the Czechoslovak nuclear programme; Jihlava, Czechoslovakia (7 Dec 1982).

The work is described of the Nuclear Information Centre in international cooperation with the CMEA countries and the contribution of the Centre to the solution of various experiments and tasks set by the IAEA in Vienna.

6929 (INIS-mf—9091, pp 17-20) **Main developmental trends of automated systems with respect to possible international cooperation in the Czechoslovak system, especially in the nuclear programme branch.** Vlasak, R. (Ustredi Vedeckych, Technickych a Ekonomickych Informaci, Prague (Czechoslovakia). Usek Technickoekonomickych Informaci). 1982. (In Czech). NTIS (US Sales Only), PC A08/MF A01. File Number TI85780139. (CONF-821288—).

From National seminar on the system of scientific and technical information for the Czechoslovak nuclear programme; Jihlava, Czechoslovakia (7 Dec 1982).

A central technical base for automated data processing was set up at the Centre for Scientific, Technical and Economic Information. The concept is described of a network of so-called technological nodal points as regional and branch workplaces located in different parts of the Republic and the network of on-line access to foreign data base centres.

6930 (INIS-mf—9091, pp 43-46) **Information sources of the library of the Institute for the Research, Production and Application of Radioisotopes (UVVVR).** Zahalkova, B. (Ustav pro Vyzkum, Vyrobu a Vyuziti Radioisotopu, Prague (Czechoslovakia)). 1982. (In Czech). NTIS (US Sales Only), PC A08/MF A01. File Number TI85780139. (CONF-821288—).

From National seminar on the system of scientific and technical information for the Czechoslovak nuclear programme; Jihlava, Czechoslovakia (7 Dec 1982).

Most information requirements of the UVVVR are met by its library from its own files, from the libraries of the Czechoslovak nuclear programme and from loans from abroad. Various sources of information and methods of providing them are described.

6931 (INIS-mf—9091, pp 58-62) **Current state and prospects of utilization of information services of the Nuclear Information Centre by the Nuclear Power Plant Research Institute.** Stefanik, J. (Vyskumny Ustav Jadrovych Elektrarni, Jaslovske Bohunice (Czechoslovakia)). 1982. (In Slovak). NTIS (US Sales Only), PC A08/MF A01. File Number TI85780139. (CONF-821288—).

From National seminar on the system of scientific and technical information for the Czechoslovak nuclear programme; Jihlava, Czechoslovakia (7 Dec 1982).

The aims are given of the main research activity of the institute and of the provision of information materials for this activity. The cooperation is described of the Institute and the Nuclear Information Centre, the use of INIS output, literature searches and other materials.

6932 (INIS-mf—9091, pp 68-71) **INIS output - an information service of the Nuclear Information Centre.** Blazek, J. (Ceskoslovenska Komise pro Atomovou Energii, Zbraslav nad Vltavou. Ustredni Informacni Stredisko pro Jaderny Program). 1982. (In Czech). NTIS (US Sales Only), PC A08/MF A01. File Number TI85780139. (CONF-821288—).

From National seminar on the system of scientific and technical information for the Czechoslovak nuclear programme; Jihlava, Czechoslovakia (7 Dec 1982).

The INIS output service processes search queries and distributes search printouts. Modern computer technology is used for retrieval from the INIS data base.

6933 (INIS-mf—9091, pp 72-74) **Microfiche library and services provided.** Nadvornik, M. (Ceskoslovenska Komise pro Atomovou Energii, Zbraslav nad Vltavou. Ustredni Informacni Stredisko pro Jaderny Program). 1982. (In Czech). NTIS (US Sales Only), PC A08/MF A01. File Number TI85780139. (CONF-821288—).

From National seminar on the system of scientific and technical information for the Czechoslovak nuclear programme; Jihlava, Czechoslovakia (7 Dec 1982).

The microfiche library of the Nuclear Information Centre fulfils its function in collecting, processing, storing and disseminating information sources. The library follows up on the INIS output service. The loaning service is described.

6934 (INIS-mf—9091, pp 75-79) **Branch file system for nonconventional literature from the nuclear field.** Dvorakova, K. (Ceskoslovenska Komise pro Atomovou Energii, Zbraslav nad Vltavou. Ustredni Informacni Stredisko pro Jaderny Program). 1982. (In Czech). NTIS (US Sales Only), PC A08/MF A01. File Number TI85780139. (CONF-821288—).

From National seminar on the system of scientific and technical information for the Czechoslovak nuclear programme; Jihlava, Czechoslovakia (7 Dec 1982).

The branch filing system collects research and study reports, translations, trip reports, literature searches and information on scientific and technical events in Czechoslovakia. The method is described of filing, processing and use of the materials.

6935 (INIS-mf—9091, pp 98-101) **INIS development and short-term prospects.** Kakos, A. (Ceskoslovenska Komise pro Atomovou Energii, Zbraslav nad Vltavou. Ustredni Informacni Stredisko pro Jaderny Program). 1982. (In Czech). NTIS (US Sales Only), PC A08/MF A01. File Number TI85780139. (CONF-821288—).

From National seminar on the system of scientific and technical information for the Czechoslovak nuclear programme; Jihlava, Czechoslovakia (7 Dec 1982).

The establishment and development of INIS are briefly described as is Czechoslovakia's contribution to its development.

6936 (INIS-mf—9091, pp 102-106) **Co-ordination and methodological guidance of information activities in the Czechoslovak nuclear programme in building the branch information system.** Nejezchleb, V. (Ceskoslovenska Komise pro Atomovou Energii, Zbraslav nad Vltavou. Ustredni Informacni Stredisko pro Jaderny Program). 1982. (In Czech). NTIS (US Sales Only), PC A08/MF A01. File Number TI85780139. (CONF-821288—).

From National seminar on the system of scientific and technical information for the Czechoslovak nuclear programme; Jihlava, Czechoslovakia (7 Dec 1982).

The work of the control unit is described which secures the optimal operation of the system, its internal functions and its linkage with other systems. The aim of coordination and methodological activity is to strengthen working and organizational links within the framework of the construction and operation of sector information systems, the establishment of cooperation relations and the elimination of duplicity.

6937 (INIS-mf—9091, pp 152-155) **Assessment of specialized journals.** Vymetal, L. (Ustav Jaderneho Vyzkumu CSKAE, Rez (Czechoslovakia)). 1982. (In Czech). NTIS (US Sales Only), PC A08/MF A01. File Number TI85780139. (CONF-821288—).

From National seminar on the system of scientific and technical information for the Czechoslovak nuclear programme; Jihlava, Czechoslovakia (7 Dec 1982).

The problems are described of the optimal selection of specialized journals. The following methods are used for the evaluation of the journals according to their information value: questionnaires, frequency analyses, citation methods and methods based on automated information systems.

6938 (INIS-mf—9091, pp 47-53) **Categories and effective forms of high level information activities for securing operation of the branch information centre at UVVVR.** Peknice, J.R. (Ustav pro Vyzkum, Vyrobu a Vyuziti Radioisotopu, Prague (Czechoslovakia)). 1982. (In Czech). NTIS (US Sales Only), PC A08/MF A01. File Number TI85780139. (CONF-821288—).

From National seminar on the system of scientific and technical information for the Czechoslovak nuclear programme; Jihlava, Czechoslovakia (7 Dec 1982).

The establishment, history and activity are described of the branch information centre of the UVVVR as is the use of various forms of information activities. Factors are described which have positive and negative impacts on the organization of the information system.

6939 (INIS-mf—9091, pp 80-83) **Publication and editing activities of the Nuclear Information Centre.** Suchanek, O. (Ceskoslovenska Komise pro Atomovou Energii, Zbraslav nad Vltavou. Ustredni Informacni Stredisko pro Jaderny Program). 1982. (In Czech). NTIS (US Sales Only), PC A08/MF A01. File Number TI85780139. (CONF-821288—).

From National seminar on the system of scientific and technical information for the Czechoslovak nuclear programme; Jihlava, Czechoslovakia (7 Dec 1982).

The publishing department of the Nuclear Information Centre is concerned with the preparation and production of publications for workers of the Czechoslovak nuclear program and of central bodies. The current state of publishing activities is described and the intentions of further development listed.

6940 (INIS-mf—9091, pp 91-97) **Development activities of the Nuclear Information Centre and their goals in the seventh five-year plan.** Kratochvil, V. (Ceskoslovenska Komise pro Atomovou Energii, Zbraslav nad Vltavou. Ustredni Informacni Stredisko pro Jaderny Program). 1982. (In Czech). NTIS (US Sales Only), PC A08/MF A01. File Number TI85780139. (CONF-821288—).

From National seminar on the system of scientific and technical information for the Czechoslovak nuclear programme; Jihlava, Czechoslovakia (7 Dec 1982).

The program is presented of the development of the Nuclear Information Centre and of the development of the Czechoslovak system of scientific and technical information. The composition is described of the tasks of the State plan for the development of science and technology in the field of information science.

6941 (INIS-mf—9091, pp 107-111) **Education of information users and promotional operations of the branch information centre.** Kohoutova, J. (Ceskoslovenska Komise pro Atomovou Energii, Zbraslav nad Vltavou. Ustredni Informacni Stredisko pro Jaderny Program). 1982. (In Czech). NTIS (US Sales Only), PC A08/MF A01. File Number TI85780139. (CONF-821288—).

From National seminar on the system of scientific and technical information for the Czechoslovak nuclear programme; Jihlava, Czechoslovakia (7 Dec 1982).

The Nuclear Information Centre also operates in the field of education and publicity. It organizes seminars, symposia and exhibitions in Czechoslovakia and abroad and has processed handbooks for INIS output users. Working excursions are also organized to the Nuclear Information Centre.

6942 (INIS-mf—9091, pp 122-130) **Publishing, editing and reprographic activities of UVVVR as branch information centre.** Peknice, J.R. (Ustav pro Vyzkum, Vyrobu a Vyuziti Radioisotopu, Prague (Czechoslovakia)). 1982. (In Czech). NTIS (US Sales Only), PC A08/MF A01. File Number TI85780139. (CONF-821288—).

From National seminar on the system of scientific and technical information for the Czechoslovak nuclear programme; Jihlava, Czechoslovakia (7 Dec 1982).

The publishing activity of the UVVVR is the link between the creative, processing and user fields. A brief characteristic is presented of publications put out by the Institute, such as Radioisotopes, Collections of Studies in the Field of Nuclear Science and Technology, and UVVVR Reports. Reprographic equipment and services are described.

6943 (INIS-mf—9091, pp 131-139) **Possibilities and implementation of information and informatics operations of the branch centre for scientific and technical information at UJV.** Moravec, A.; Tlalka, R. (Ustav Jaderneho Vyzkumu CSKAE, Rez (Czechoslovakia)). 1982. (In Czech). NTIS (US Sales Only), PC A08/MF A01. File Number TI85780139. (CONF-821288—).

From National seminar on the system of scientific and technical information for the Czechoslovak nuclear programme; Jihlava, Czechoslovakia (7 Dec 1982).

The Nuclear Research Centre processes methodological analytical studies for the development of long-term concepts of the development of the nuclear energy complex. The information services of the Centre are secured by the department of technical and economic information which consists of three main groups which have their separate tasks: the library, the documentation unit and the press unit. The use of the services of INIS, CA-Search and the DERWENT data base are described.

6944 (INIS-mf—9091, pp 140-146) **Activities of the branch information centre of the Institute of Radioecology and Uses of Nuclear Technology in Kosice.** Koukolova, M. (Ustav Radioekologie a Vyuzitia Jadrovej Techniky, Kosice (Czechoslovakia)). 1982. (In Slovak). NTIS (US Sales Only), PC A08/MF A01. File Number TI85780139. (CONF-821288—).

From National seminar on the system of scientific and technical information for the Czechoslovak nuclear programme; Jihlava, Czechoslovakia (7 Dec 1982).

The tasks are presented of the information centre of the institute in the following areas: environmental impacts of nuclear energy, radioecology, the use of nuclear methods for monitoring the chemical pollution of the environment, selected nuclear instruments and radioimmunassay methods and instruments. The work is described of the library, publishing unit, translators, retrieval and reprographic units.

6945 (INIS-mf—9091, pp 147-151) **Intents of the Nuclear Information Centre in analytical study activities.** Vanek, V. (Ceskoslovenska Komise pro Atomovou Energii, Zbraslav nad Vltavou. Ustredni Informacni Stredisko pro Jaderny Program). 1982. (In Czech). NTIS (US Sales Only), PC A08/MF A01. File Number TI85780139. (CONF-821288—).

From National seminar on the system of scientific and technical information for the Czechoslovak nuclear programme; Jihlava, Czechoslovakia (7 Dec 1982).

The beginnings and development are described of the study and analytical work of the Nuclear Information Centre. The main stages of the implementation of this activity are described and basic measures discussed which have been suggested for its improvement.

6946 **(INIS-mf—9401) Nuclear options in Latin America. Background brief.** (Foreign and Commonwealth Office, London (UK)). Nov 1983. 5p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85780183.

An account is given of the Treaty of Tlatelolco, 1967, providing for the designation of Latin America as a Nuclear Weapon-Free Zone (NWFZ); additional protocols attached to the Treaty are available for signature by States outside the region. The Treaty is administered by the Organisation for the Prohibition of Nuclear Weapons in Latin America (OPANAL). Reference is made to its latest meeting, held in May 1983. The present paper also discusses the following: Non-Proliferation Treaty (with references to safeguards agreements concluded between each State and the IAEA); nuclear suppliers' group; peaceful nuclear explosions; nuclear energy programmes in Latin America.

## 2910 Conservation

*REFER ALSO TO CITATION(S) 2910006968, 6974, 6975, 7011*

## 2920 Supply, Demand, And Forecasting

*REFER ALSO TO CITATION(S) 2920006340, 6401, 6903, 6951*

6947 **(DOE/NBM—5003626) Energy in the future: a series of three lectures.** Putnam, P. (USAEC, Washington, DC). Jun 1953. 118p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE85003626.

Our hypothetical Trustee recognizes that the economic and social pressures directed at finding new sources of abundant low-cost energy are about to become compelling. As a prudent Trustee, he would say the time for action has come. He would urge that the nation's talents, public and private, be released for the development of nuclear furnaces (reactors) capable of furnishing heat for the generation of electricity, for district central heating and for industrial process heating. He would urge that we continue to explore nuclear reactions other than the fission of uranium and thorium. There is hope of domesticating the fusion reaction that makes the hydrogen bomb go. Economical fusion of the hydrogen contained in a cubic mile of sea water would be a source of capital energy equal to all conceivable needs for many hundreds of years. He would be concerned about the vast quantities of metals, some of them already in short supply, that would be required by very large nuclear power programs. He would suggest that we search for these metals by methods yet to be developed, and in novel places, including the sea. Finally, as our ultimate anchor to windward, he would urge the exploration of all ways to obtain income energy from sunlight in more useful forms and at lower costs than now appear possible.

## 2930 Policy, Legislation, And Regulation

*REFER ALSO TO CITATION(S) 2930006394, 6463, 6910, 6993, 7377, 7385, 8086*

6948 **(INIS-mf—9412) Regulations on provision of technical support for projects by the Turkish Atomic Energy Authority.** (Turkey). 16 May 1983. 4p. (In Turkish). NTIS (US Sales Only), PC A02/MF A01. File Number DE85780186.

These regulations were made in compliance with the 1982 Act establishing the Turkish Atomic Energy Authority which prescribes that the Authority will provide support for projects in the nuclear field. The Regulations specify that it will provide laboratory equipment as well as staff and financial assistance to such projects.

## 2940 Fossil Fuels

*REFER ALSO TO CITATION(S) 2940006356, 6356, 6362, 6373, 6379, 6381, 6387, 6388, 6391, 6392, 6392, 6394, 6401, 6412, 6413*

6949 **(NP—5770108) Oil price development and structural changes in the OPEC countries.** Bruch, M.; Dicke, H.; Glismann, H.H. (Kiel Univ. (Germany, F.R.). Inst. fuer Weltwirtschaft). Jun 1983. 42p. (In German). NTIS (US Sales Only), PC A03/MF A01. File Number DE85770108.

After some statements on the consequences of the oil price increase, two hypotheses on pricing (Ricardo/Hotelling hypothesis and cartel hypothesis) are studied with a view to their empirical relevance. The structural effects of different price expectations are derived and discussed.

6950 **(NP—5770111) Natural gas today and tomorrow.** (Ruhrgas A.G., Essen (Germany, F.R.)). Jul 1984. 30p. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE85770111.

The report gives a comprehensive survey of the situation of natural gas in the Federal Republic of Germany and deals with the following topics: natural gas in the heat market, improvement of the safety of energy supply, environmental compatibility of natural gas, its contribution towards energy conservation, market prices, the safety of energy supply at long term, and the prospects of the German gas economy.

6951 **(NP—5900373) World Energy.** Clark, S.H. (Stanford Research Inst., Menlo Park, CA (USA)). Nov 1972. 23p. NTIS, PC A02/MF A01. File Number DE85900373.

World energy is a complex subject that is rapidly becoming more complex. In this report the emphasis is on major changes foreseen in the world energy situation - particularly those that can significantly influence energy pricing - although the basic framework within which these changes should be viewed is also set forth. Consideration is given to the long term outlook (1980-1990) as well as to developments over the next few years, and some observations are made concerning the longer term after 1990. The energy situation (supplies, demand, pricing, and policy) for the US, Canada, Western Europe, and Japan is discussed for the years 1970-1978. Commodities considered include coal, oil, gas, hydroelectric, and nuclear power. 20 figures, 8 tables.

## 2950 Hydrogen And Synthetic Fuels

*REFER ALSO TO CITATION(S) 2950006556*

## 2960 Electric Power

*REFER ALSO TO CITATION(S) 2960007040*

6952 **(DOE/EIA—0226(84/08)) Electric Power Monthly, August 1984.** (USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels). Nov 1984. 43p. NTIS, PC A03/MF A01 - GPO; GPO Dep. File Number DE85003440.

The Electric Power Monthly (EPM) includes comprehensive information about the electric utility industry in the United States. Detailed, plant-level data are contained in the Electric Power Quarterly. The summarized data contained in this report are presented for the use of a wide audience including Congress, federal and state agencies, the electric utility industry, and the general public. The data presented in this report were collected and published by the Energy Information Administration (EIA), US Department of Energy, to fulfill its data collection and dissemination responsibilities as specified in the Federal Energy Administration Act of 1974 (P.L. 93-275) as amended. Data for 1983 presented herein are revised and final; all 1984 data are preliminary.

6953 **(DOE/EIA—M001) Model documentation: electricity market module.** Sanders, R.C.; Murphy, F.H. (USDOE Energy Information Administration, Washington, DC. Office of Energy Markets and End Use). Dec 1984. 104p. NTIS, PC A06/MF A01; 1 - GPO; GPO Dep. File Number DE85004587.

This report documents the electricity market model. This model is a component of the Intermediate Future Forecasting System (IFFS), the energy market model used to provide projections of energy markets up to 15 years into the future. The electricity market model was developed by the Supply Analysis and Integration Branch as part of building the larger system. This report is written for an audience consisting of mathematical economists, statisticians, operations research analysts, and utility planners. This report contains an overview and a mathematical specification of the electricity market module. It includes a description of the model logic and the individual subroutines in the computer code. A companion document Intermediate Future Forecasting System: Executive Summary (DOE/EIA-430) provides an overview of the components in IFFS and their linkages. 22 figures, 2 tables.

6954 **(DOE/RG/06353—T2) National Power Grid Study, Chapter 13. Financial/economic implications of S.1991. Final report, Task 12.** (Little (Arthur D.), Inc., Cambridge, MA (USA)). Feb 1979. Contract AC01-78RG06353. 67p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85001687.

In this chapter, we examine the implications of strengthening our bulk power system (generation and/or transmission) on future electric utility structures, and the financial/economic implications for investors, customers and communities. Our analysis is based on the examination of various degrees of government intervention necessary to meet perceived national, regional or local needs which cannot or will not be met by either individual or coordinated utilities. Constraints which impede better coordination amoungst utilities are cited and ways of alleviating their impact have been developed where possible.

6955 **(DOE/RG/06353—T3) National Power Grid Study, Chapter 11. Joint utility projects: financial issues and impediments. Final report, Task 11.** (Little (Arthur D.), Inc., Cambridge, MA (USA)). Feb 1979. Contract AC01-78RG06353. 107p. NTIS, PC A06/MF A01; GPO Dep. File Number DE85001642.

In this chapter we examine the financial issues, particularly the impediments, impacting joint projects. We base our analysis on numerous interviews and an in-depth study of two joint projects. From the utility perspective, we discuss the positive and negative aspects of joint projects in relation to the financial/regulatory environment. We discuss impediments specific to joint projects, that is, obstacles which arise as a result of multiple ownership. Finally, we suggest alternatives which might be applied to reduce the effects of impediments and encourage joints projects.

6956 **(DOE/RG/10237—T1) Consumers' Utility Counsel Section, Office of Consumer Services Grant, October 1, 1979-December 31, 1981. Final report.** Cauley, W. (Alabama Office of the Attorney General, Montgomery (USA)). 30 Dec 1981. Contract FG01-79RG10237. 29p. NTIS, PC A03. File Number DE84016526.

Activities of the CUC, with the aid of a OCS grant, include intervention on behalf of residential ratepayers before the Alabama

Public Service Commission (APSC), assistance to other consumer groups, representation of consumer interests in cases before FERC, and study of technical matters in the PURPA act. The activities done in regard to APSC Docket 17859, a rate application by Alabama Power Co., are described. (DLC)

6957 **(PNL-SA—12246) Observations on electricity planning under the Northwest Power Act.** Fang, J.M. (Pacific Northwest Lab., Richland, WA (USA)). Apr 1984. Contract AC06-76RL01830. 45p. (CONF-8405200—2; CONF-8406222—1). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85003106.

From 18. annual Pacific Northwest Regional Economic conference; Olympia, WA, USA (3 May 1984).

The purpose of this paper is to present an overview of electricity planning in the Pacific Northwest conducted by the Power Council so as to gain a preliminary understanding of how the process can be applicable or adapted to other regions in the US. Following this introduction, a short discussion on the background of the Northwest Power Act is provided. Then, the roles of the Power Council and the Bonneville Power Administration (BPA) under the Act and other statutes are briefly described. Subsequently, the planning process including the public involvement process is explained. Tentative observations are then discussed in some detail.

## 2980 Consumption And Utilization

*REFER ALSO TO CITATION(S) 2980006353, 6387, 6401, 6960*

6958 **(DOE/EIA—0321/1(82)) Residential energy consumption survey: consumption and expenditures, April 1982-March 1983. Part 1, national data.** Thompson, W. (USDOE Energy Information Administration, Washington, DC. Office of Energy Markets and End Use). Nov 1984. 223p. NTIS, PC A10/MF A01; 1 - GPO; GPO Dep. File Number DE85003461.

This report presents data on the US consumption and expenditures for residential use of natural gas, electricity, fuel oil or kerosene, and liquefied petroleum gas (LPG) from April 1982 through March 1983. Data on the consumption of wood for this period are also presented. The consumption and expenditures data are based on actual household bills, obtained, with the permission of the household. from the companies supplying energy to the household. Data on wood consumption are based on respondent recall of the amount of wood burned during the winter and are subject to memory errors and other reporting errors described in the report. These data come from the 1982 Residential Energy Consumption Survey (RECS), the fifth in a series of comparable surveys beginning in 1978. The 1982 survey is the first survey to include, as part of its sample, a portion of the same households interviewed in the 1980 survey. A separate report is planned to report these longitudinal data. This summary gives the highlights of a comparison of the findings for the 5 years of RECS data. The data cover all types of housing units in the 50 states and the District of Columbia including single-family units, apartments, and mobile homes. For households with indirect energy costs, such as costs that are included in the rent or paid by third parties, the sonsumption and expenditures data are estimated and included in the figures reported here. The average household consumption of natural gas, electricity, fuel oil or kerosene, and LPG dropped in 1982 from the previous year, hitting a 5-year low since the first Residential Energy Consumption Survey (RECS) was conducted in 1978. The average consumption was 103 (+-3) million Btu per household in 1982, down from 114 (+-) million Btu in 1981. The weather was the main contributing factor. 8 figures, 46 tables.

6959 **(INIS-mf—9190) Data on the development of the West German power industry in 1982.** (Bundesministerium fuer Wirtschaft, Bonn (Germany, F.R.)). Jul 1983. 70p. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE85780148.

After a general review of the national and international energy situation and some general remarks concerning the supply of the most important energy sources in the Federal Republic of Germany, detailed figures of energy production, consumption, and trade are presented in tabular and graphical form in comparison with past years, help to make trends clearer.

## 2990 Unconventional Sources And Power Generation

*REFER ALSO TO CITATION(S) 2990006662, 6671*

6960 **(DOE/EIA—0341(83)) Estimates of US wood energy consumption 1980-1983.** (USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels). Nov 1984. 69p. NTIS, PC A04/F A01 - GPO; GPO Dep. File Number DE85003669.

Use of wood energy in the United States from 1900 to the mid-1970's decreased as low-price coal, oil, natural gas, and electricity became available. The recent, dramatic increases in fossil fuel prices have led to a resurgence of wood use as a fuel and, also, greater interest in wood consumption data. No single national survey has been designed to measure wood energy consumption. The first attempt to publish comprehensive estimates of wood energy consumption was made by the Energy Information Administration (EIA) in 1982. The objective of this report is to update the earlier report and to present wood consumption data by region and sector. To achieve this objective without having to conduct a survey, the most reliable sources were sought, and appropriate methodologies were developed to measure wood consumption. The data developed in this report show that in 1983 wood provided approximately 3.6% of the total primary energy consumed in the United States. It is the sixth largest supplier of energy behind oil, gas, coal, nuclear fuels, and electric power. Wood represents a much smaller share of US energy consumption than oil, gas, or coal but is close to hydroelectric and nuclear power. Also, wood was found to be a key fuel in the industrial and residential sectors. In 1983, 7.9% of the end-use energy consumed by industry was wood. In specific industries, such as the Paper and Allied Products industry and the Lumber and Wood Products industry, wood made up 50 to 75% of the energy consumed. In the same year, consumption of wood constituted approximately 9.6% of the end-use energy consumed by the residential sector. Total US wood consumption from 1980 through 1983, by sector, is presented numerically and schematically. 13 figures, 13 tables.

6961 **(NP—5900396) Renewable energy: energy from agricultural products.** (Florida Governor's Energy Office, Tallahassee (USA)). Jun 1984. 21p. Governor's Energy Office, The Capital, Tallahassee, FL 32301. File Number TI85900396.

This study discusses major issues concerning fuels derived from agricultural products. Agricultural products, particularly sugarcane and corn, are currently meeting major energy needs in Florida. Recent figures indicate that about 10% of the gasoline sold in Florida is ethanol enriched. This gasohol contains a 10% mix of ethanol, which is generally produced from corn or sugarcane molasses. Sugarcane residues (bagasse) also supply most of the fuel to power Florida's large sugar processing industry. These products have the potential to play an expanded role in Florida's energy future. Principle areas of interest are: Growing crops such as napier grass or harvesting water hyacinths to produce methane that can be substituted for natural gas; expanded use of sugar, starch, and industrial and agricultural wastes as raw materials for ethanol production; improved efficiency in conversion processes such as anaerobic digestion and fermentation. The Institute of Food and Agricultural Sciences at the University of Florida plays a leading national role in energy crops research, while Walt Disney World is using a demonstration project to convert water hyacinths into methane. Increased use of fuels produced from agricultural products depends largely on their costs compared to other fuels. Ethanol is currently attractive because of federal and state tax incentives. The growth potential of ethanol and methane is enhanced by the ease with which they can be blended with fossil fuels and thereby utilize the current energy distribution system. Neither ethanol nor methane appear able to compete in the free market for mass distribution at present, although studies indicate that genetic engineering and more efficient conversion processes may lower prices to cost effective levels. These fuels will be most cost effective in cases where waste

products are utilized and the fuel is used close to the site of production.

# 30 DIRECT ENERGY CONVERSION

## 3005 Fuel Cells

*REFER ALSO TO CITATION(S) 3005006898*

**6962 (AD-A—143402/6) Fuel cell power systems for navy applications. Final report October 1981-November 1982.** Major, W.R.; Miles, C.R. (Naval Civil Engineering Lab., Port Hueneme, CA (USA)). May 1984. 74p. (NCEL-TN—1696). NTIS, PC A04/MF A01.

A fuel cell power plant can supply both thermal and electrical energy to a site load. The technical and economic attractiveness of using a fuel cell system for a given application depends on many factors such as: satisfying load requirements, reliability, local energy costs, and capital costs. Satisfying site load requirements cost effectively requires a properly sized fuel cell system operating in its optimum mode. A computer program was developed to simulate the dynamic input/outputs of the fuel cell system (fuel cell, auxiliary boiler, thermal storage, electrical grid) and evaluate the separate system operational costs. Using the computer simulation in an iterative method, the optimum operational mode and size of the fuel cell and thermal storage can be estimated. A life-cycle-cost analysis for a given application can be performed using current manufacturer hardware costs and energy input/output data generated from the computer simulation.

**6963 (DOE/ET/17089—9) High-temperature, solid oxide electrolyte fuel cell power generation system. Quarterly summary report, August 1, 1982-October 3, 1982.** Feduska, W. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Center). Jan 1984. Contract AC02-80ET17089. 27p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85002978.

Work has proceeded in improving the porous support tube quality through refinements made in the sintering equipment and in processing of the zirconia powder. The lanthanum manganite air electrode is being characterized with respect to its behavior when subjected to the fuel cell component fabrication conditions, to which it is exposed. The large EVD reactor is nearing completion of assembly. Good 20 cm long interconnection depositions (of proper chemical composition) must still be achieved before test cells can be fabricated. Systems studies are underway in which the solid oxide fuel cell generator is being applied to selected power plant and cogeneration systems to determine their economic worth, based on the present state of cell technology.

**6964 (DOE/FE/60338—T5) Phosphoric acid electric utility fuel cell technology development. Technical progress report No. 16.** Breault, R.D.; Briggs, T.A.; Congdon, J.V.; Gelting, R.L.; Goller, G.J.; Luoma, W.L.; McCloskey, M.W.; Mientek, A.P.; O'Brien, J.J.; Randall, S.A. (United Technologies Corp., South Windsor, CT (USA). Power Systems Div.). Aug 1984. Contract AC21-83FE60338. 46p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85003278.

Over 550 hours and four thermal cycles with performance close to the E-line goal have been accumulated on the second 10-ft$^2$ 28-cell stack at 120 psia and 405°F. Over 12,400 hours and 35 thermal cycles have been accumulated on the 3.7-ft$^2$ 30-cell stack at 120 psia and 405°F. A subscale cell cut from 10-ft$^2$ electrodes in the same batch used for the second 10-ft$^2$, 28-cell stack has accumulated over 2200 hours with performance close to E-line at 120 psia and 400°F. Testing was completed on the first three builds of the 7-cell, crosspressure tolerance stack.

**6965 (DOE/NASA—0238-1) Electrocatalysis of fuel cell reactions: investigation of alternate electrolytes.** Chin, D.T.; Hsueh, K.L.; Chang, H.H. (Clarkson Coll. of Tech., Potsdam, NY (USA)). Jan 1984. Contract AI21-80ET17088. 112p. (NASA-CR—174753). NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE85003071.

This work is concerned with a study of oxygen reduction and transport properties of the electrolyte in the phosphoric acid fuel cell. The areas covered in the work were: (1) development of a theortical expression for the rotating ring-disk electrode technique; (2) determination of the intermediate reaction rate constants for oxygen reduction on platinum in phosphoric acid electrolyte; (3) determination of oxygen reduction mechanism in trifluoromethanesulfonic acid (TFMSA) which has been considered as an alternate electrolyte for the acid fuel cells; and (4) the measurement of transport properties of the phosphoric acid electrolyte at high concentrations and temperatures.

**6966 Structure-property relationships of anionic exchange membranes for Fe/Cr redox storage batteries.** Arnold, C. Jr.; Assink, R.A. (Sandia National Laboratories, Albuquerque, NM). *Journal of Applied Polymer Science;* **29**: No. 7, 2317-2330(Jul 1984). Contract AC04-76DP00789.

Membranes with lower area resistivity, higher selectivity, and reduced susceptibility toward fouling were required to improve the efficiency and lifetime of Fe/Cr redox storage batteries. The relationship of membrane structure to these electrochemical properties was not well understood. To gain a better understanding of structure-property relationships, a series of model membranes was synthesized in which the degree of crosslinking, ion exchange capacity, and porosity could be varied independently. This permitted the completion of several factorial studies in which the effect of each structural variable and interaction between variables could be defined and quantified. It was found that increasing the ion exchange capacity had a beneficial effect on all three electrochemical properties. Increasing the porosity reduced the resistivity and fouling but resulted in poorer selectivity. The degree of crosslinking had no effect on resistivity but improved selectivity and reduced fouling was observed when this parameter was increase. These relationships are consistent with theoretical models that have been proposed to account for the behavior of ion exchange membranes in general. From this data, empirical models were constructed which could be used to predict the area resistivity and water content of other anionic exchange membranes. 15 references, 8 figures, 4 tables.

## 3008 Miscellaneous Converters

**6967 (DOE/ER/10347—T1) Research and development program on a sodium heat engine. Final report.** Hunt, T.K.; Weber, N. (Ford Motor Co., Dearborn, MI (USA). Research Staff). Oct 1982. Contract AC02-79ER10347. 160p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE85003820.

The following aspects of the sodium heat engine are covered: basic principles of operation, materials properties, experimental design and test results, system design considerations, power conditioning studies, and application studies. (MHR)

# 32 ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

**6968 (PB—84-236207) Second energy R and D (Research and Development) programme. Energy conservation (1979-83): survey of results.** Zegers, P.; Pilavachi, P.A. (Commission of the European Communities, Luxembourg). 1984. 296p. (EUR—8661-EN). NTIS, PC E14/MF E14.

On 11 September 1979 the Council of Ministers approved a second four-year energy R and D program of which energy conservation R and D the Commission concluded more than 150 research contracts with organizations of undertakings in the Member States of the European Community. The cost of this R and D program was around 55 million ECU of which half was paid by the Commission. Energy saving R and D is executed in five major fields: buildings, industry, transport, energy production, and energy storage. In this book the work performed under contracts in the second energy conservation R and D program (1979-83) is described in the form of one-page summaries.

## 3201 Buildings

*REFER ALSO TO CITATION(S) 3201006609, 6611, 6612, 6627, 6630, 6632, 6632, 6633, 6634, 6658, 6668, 7040*

6969 **(AD-A—144136/9) Demand controlled economizer cycles: a direct digital control scheme for heating, ventilating, and air conditioning systems.** Tom, S.T. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA)). May 1984. 259p. NTIS, PC A12/MF A01.

An improved economizer control was developed which based the control decision on the measured demand for hot and cold air. The control system was activated in January of 1984 and was operated through February, March, and April. Data taken during these months showed the experimental control system reduced the coil operating costs by over 20% during February and March, and reduced costs by over 30% during Aprii. A computer simulation of this system predicted an annual savings of 22%, or approximately $2200 for the HVAC system being studied. The payback period for the demand controlled economizer ranged from 6 months (if added to an existing DDC system) to 2 years (if installed as a stand-alone system). In addition to studying the performance of the experimental control system, the instrumentation installed as part of this experiment allowed the entire HVAC system to be studied. Temperature sensors, coil stratification, and perimeter heating systems are among the topics discussed in this thesis.

6970 **(CONF-841231—1) International Energy Agency Heat Pump Center.** Creswick, F.A. (Oak Ridge National Lab., TN (USA)). 1984. Contract AC05-84OR21400. 5p. NTIS, PC A02/F A01; GPO Dep. File Number DE85003332.

From DOE/ORNL heat pump conference; Washington, DC, USA (10 Dec 1984).

The Heat Pump Center, its activities, and the potential benefits to US organizations are described briefly. (MHR)

6971 **(CONF-841231—2) DOE/ORNL electric systems program overview.** Fairchild, P.D. (Oak Ridge National Lab., TN (USA)). 1984. Contract AC05-84OR21400. 15p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003334.

From DOE/ORNL heat pump conference; Washington, DC, USA (10 Dec 1984).

Major projects in these areas include two field experiments, one laboratory study, one data survey and an analytical effort. Of the two field experiments, one is being conducted by ORNL at the local TECH site near Knoxville and the other by Westinghouse in a residence near Pittsburgh. The TECH-site work has focused on state-of-the-art (SOA) single-speed residential air-to-air heat pumps for the past few years, but is currently changing to a SOA two-speed unit. The Westinghouse preprototype dual-stroke advanced heat pump developed under a previous DOE/ORNL cost-shared contract is being tested at Pittsburgh. The ORNL laboratory study is aimed at detailed measurement of refrigerant migration with varying on-off cycles, frost formation with varying relative humidities, and other such factors to develop an understanding of effect and cause of dynamic losses. The field performance data survey is a project to determine the extent and quality of data that is available on heat pump field performance from manufacturers, utilities, and others.

6972 **(CONF-8203195—) Ventilation in housing.** (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Projektleitung Energieforschung). 1982. 139p. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number DE85770075.

From Information meeting on the research and development project on ventilation in housing; Juelich, F.R. Germany (25 Mar 1982).

The development project, 'Ventilation in Housing', is part of the general programme for energy research and energy technology. It is the aim of the project to investigate possible ways of decreasing ventilation, heat losses from housing by use of structural and constructional means. The project 'Ventilation in Housing', comprises plans from various specialised fields. Investigations into occupied multiple dwellings receive much attention. The conference report gives a summary of the project as a whole, the individual sub-projects as well as the available results. For each of the 12 papers a separate conclusion was drawn with regard to their content.

6973 (CONF-8203195—, pp 5-14) **Rational energy usage - aims of the general energy research and technology program of the Federal Government.** Hlawiczka, H. 1982. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number TI85770075.

From Information meeting on the research and development project on ventilation in housing; Juelich, F.R. Germany (25 Mar 1982).

In approximately 15 million dwellings in the Federal Republic of Germany energy-saving measures are urgently needed. In households alone 50 million s.t.e. could be saved in the next 10 to 20 years, that would be a halving in consumption. Within the context of the project, 'Ventilation in Housing', the possibilities of reducing ventilation heat loss are to be investigated, by considering economic perspectives. The paper goes into the initial situation from which the programme 'Ventilation in Housing' is carried out and into some of the trends which intermittently appeared during its course.

6974 (CONF-8203195—, pp 15-18) **Welcoming speech by the Federal Minister for Area Planning, Construction and Town Planning.** Petri, G. 1982. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number TI85770075.

From Information meeting on the research and development project on ventilation in housing; Juelich, F.R. Germany (25 Mar 1982).

Energy-saving in housing in general takes 4 forms: 1) Building plans which take the passive use of solar energy into account; 2) Insulation and choice of heating system; 3) the avoidance of ventilation heat losses or the recovery of waste air heat by unterdisciplinar co-operation of various areas; 4) The way the occupants use the heating and ventilation. Within the context of the research programme 'Ventilation in Housing' primarily information is to be gathered for points 3 and 4 which not only finds its way into practice but, where necessary, can also be used for standardisation, legislation and further uses.

6975 (CONF-8203195—, pp 19-32) **Research and development programme 'ventilation in housing' - aims, conception and state.** Trepte, L. 1982. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number TI85770075.

From Information meeting on the research and development project on ventilation in housing; Juelich, F.R. Germany (25 Mar 1982).

The programme, 'Ventilation in Housing' is to investigate the connections between and questions of various specialised fields, which have not yet been explained, and also the energy-saving potential. The different individual projects of the whole are introduced briefly. The main points of consideration are the demonstration projects in which the various ventilation installations and systems of occupied multiple dwellings are compared. A record of the results of the individual projects concluded first is given, with regard, amongst other things, to the economic efficiency of the energy, general operational and user behaviour.

6976 (CONF-8203195—, pp 33-45) **Stock-taking for designing installations for free ventilation and also ventilation systems in housing construction.** Knoebel, U.; Haberda, F. 1982. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number TI85770075.

From Information meeting on the research and development project on ventilation in housing; Juelich, F.R. Germany (25 Mar 1982).

A survey is given of the ventilation installations and systems used in dwellings at this time. In addition an assessment of both systems is undertaken, using the following criteria: possible volume stream, energy losses involved, regulatability and controlability, cost and economy as well as recognisable trends.

6977 (CONF-8203195—, pp 46-56) **Minimum ventilation depending on the kind of usage and intensity.** Wegner, J. 1982. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number TI85770075.

From Information meeting on the research and development project on ventilation in housing; Juelich, F.R. Germany (25 Mar 1982).

If the density of windows is too large, then there can no longer be the change of air actually required for reasons of hygiene and construction. The minimum change of air necessary in sitting rooms is determined. The various rooms of a dwelling are included in the investigation, as are the frequency and intensity of use. The results show that, as far as rooms with very thick windows are concerned, small ventilation coefficients can lead to high concentrations of harmful substances if one has recourse solely to natural window ventilation. Suggestions are developed for putting ventilation measures into practice, in order to make possible the required change of air in the whole dwelling with a minimum stream of outdoor air.

6978 (CONF-8203195—, pp 57-76) **Investigation for assessing the operation of fire-places in dwellings with high-density windows and doors.** Hoess, A. 1982. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number TI85770075.

From Information meeting on the research and development project on ventilation in housing; Juelich, F.R. Germany (25 Mar 1982).

As part of the project, 'Fireplaces in Housing', the following subjects are dealt with: the influence of windows and doors of varying density on the operation of fire-places; the ventilation and deaeration required, suggestions for solutions for fire-places in buildings with high-density windows and doors; the application of suggested technical solutions within the context of a demonstration construction project. The paper gives a survey of the state of work, of the results and of their significance for efficient use of energy.

6979 (CONF-8203195—, pp 77-85) **Comparison of ventilation systems in unoccupied test houses.** Werner, H. 1982. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number TI85770075.

From Information meeting on the research and development project on ventilation in housing; Juelich, F.R. Germany (25 Mar 1982).

Various ventilation installations and systems are quantitatively and qualitatively investigated in 2 test houses of the same size and construction, and with the same heating insulation. The air-exchange rates and air-change, ventilation heat losses, operational behaviour, supplementary energy requirements, etc. of various ventilation objects are compared. The aim is under practical conditions, to develop a basis of assessment for these kinds of installations, according to energy-saving criteria. A report is given of the current state of the project and of the first available results concerning air-change, heating energy consumption and the problems arising.

6980 (CONF-8203195—, pp 86-93) **Development of a standard method of testing heat recovery equipment in HVAC systems for housing ventilation.** Kuelpmann, R. 1982. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number TI85770075.

From Information meeting on the research and development project on ventilation in housing; Juelich, F.R. Germany (25 Mar 1982).

Heat recovery equipment in ventilation systems will gain in importance. Standard methods of testing are therefore required for monitoring economy and for generally recognized methods of testing. Methods and experiment requirements are investigated in a project, with the help of which the efficiency coefficient and all influence parameters essential to the operation can be determined. Possible test criteria for a standard method of testing heat recovery equipment and also the requirements of the test position are dealt with.

6981 (CONF-8203195—, pp 94-109) **Testing and comparison of various ventilation systems in solar house Freiburg.** Tesche, B.; Meier, B. 1982. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number TI85770075.

From Information meeting on the research and development project on ventilation in housing; Juelich, F.R. Germany (25 Mar 1982).

Within the context of the project, energy balances were drawn up in solar house, Freiburg for the economic and energy assessment of HVAC Systems. In addition an air outlet system and an outdoor air system, which had been installed on 2 practically identical floors, were compared. Recommendations for further projects are developed from operational experience with HVAC systems and measuring installations. Further tasks were set in the course of the investigations. The paper describes the requirements of the experiment and the energy balances and influence of humidity and the outdoor weather on heating consumption, comfortability and free change of air. In conclusion, he looks into the significance of the experiments for efficient energy use.

6982 (CONF-8203195—, pp 110-117) **Testing and comparison of various ventilation systems and installations in multiple dwellings - demonstration project Berlin.** Nikolic, V.; Rouvel, L. 1982. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number TI85770075.

From Information meeting on the research and development project on ventilation in housing; Juelich, F.R. Germany (25 Mar 1982).

By comparing different types of ventilation in various dwellings, ways of reducing the ventilation heat requirement are to be shown. Different types of dwelling are chosen, which, as far as the room or type of building ventilation is concerned, have characteristic distinctions. With the aid of measurement and observation results, measures are developed for energy conservation. The intermediary position of the project is reported on.

6983 (CONF-8203195—, pp 118-128) **Comparative investigation of various ventilation systems in constructed housing - demonstration project Worms.** Bley, H. 1982. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number TI85770075.

From Information meeting on the research and development project on ventilation in housing; Juelich, F.R. Germany (25 Mar 1982).

By using three housing projects with different ventilation systems, measurement data for assessing mechanical ventilation and deaeration systems with heat recovery are acquired. The following aspects are investigated: the technical and constructional design; energy consumption of mechanical ventilation and deaeration systems compared with conventional systems; the economic efficiency of mechanical ventilation systems with heat recovery; and the ventilation habits of the tenants.

6984 (CONF-8203195—, pp 129-137) **Testing and comparison of various ventilation systems and installations in multiple dwellings - demonstration project, Duisburg.** Truemper, H. 1982. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number TI85770075.

From Information meeting on the research and development project on ventilation in housing; Juelich, F.R. Germany (25 Mar 1982).

In the Federal Republic of Germany satisfactory data on energy conservation in mechanical ventilation and deaeration systems with heat recovery are lacking. The leakness of walls, ceiling and floor which has up until now been accepted and used to cause constructional and hygiene problems has now been eliminated because of the energy crisis and heat protection ordinance. An experimental object was subsequently fitted with mechanical ventilation and deaeration components and also a heat recovery system. Measurements should reap knowledge about energy conservation which may accelerate installation of controlled housing ventilation with heat recovery even for older buildings.

6985 **(DOE/CH/10166—T1) ECM monitoring study summary report: states of Illinois, Indiana, Michigan, Minnesota, Ohio and Wisconsin. Final report.** Stewart, E.H. (Globetrotters Engineering Corp., Chicago, IL (USA)). 14 Sep 1984. Contract AC02-83CH10166. 118p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE85003298.

Energy conservation measures (ECM's) monitoring programs for the six states are summarized. The institutional conservation programs, the monitoring programs and the summary findings and observations are presented. (MHR)

6986 **(EPRI-EM—3699) Proceedings: commercial refrigeration research workshop. Summary.** Blatt, M.H. (Science Applications, Inc., La Jolla, CA (USA)). Oct 1984. 54p. (CONF-840182—Summ.). Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $10.00. File Number TI85920150.

From Commercial refrigeration research workshop; Palo Alto, CA, USA (12 Jan 1984).

The purpose of this workshop was to identify the state-of-the-art and determine research needs for improving energy use and demand in commercial refrigeration applications. Workshop attendees included research and development, technical operations and marketing people from manufacturers of supermarket refrigeration, space conditioning, and energy management systems equipment, and from supermarket chains and electric utilities. Presentations were given on best current practice and research needs from the perspective of each of these industry segments. Working groups identified ten important research, development and equipment demonstration projects to improve the efficiency of refrigerating equipment, heating, ventilating and air-conditioning (HVAC) equipment, and other energy-using systems in supermarkets.

6987 **(LBL—16362) Residential indoor air quality/air infiltration study.** Wagner, B.S. (Lawrence Berkeley Lab., CA (USA)). Dec 1982. Contract AC03-76SF00098. 63p. (EEB-BED—83-07). NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85003454.

Indoor air quality was monitored in 16 houses in California, eleven of which had gas stoves; all had air change rates well below those estimated for 1983 Title-24 standards, recent completion dates, and low natural ventilation. Using passive monitors (small, inexpensive devices which require no power or operation by building occupants or by the author during monitoring). Levels of formaldehyde were measured in 12 Sacramento/Davis area houses, and levels of nitrogen dioxide and radon-222 in all houses. Correlation of pollutant concentration with infiltration rate and building characteristics was investigated. The results indicate that new houses with infiltration rates less than 0.5 ac/h do not necessarily experience poor indoor air quality, even without special air quality controls. However, in a few of the houses levels of formaldehyde and radon-222 above the lowest currently proposed standards or guidelines were measured. Because the house selection and monitoring period were weighted toward worst case conditions, average pollutant levels in these and similar houses may be lower and/or may decrease with time. However, a few buildings probably exist with indoor pollutant levels much higher than those we observed. Therefore, some strategy for identifying problem houses is needed. Some mitigation strategies and directions for future research are recommended.

6988 **(LBL—17173) Technical description: the Envelope Thermal Test Unit.** Modera, M.P. (Lawrence Berkeley Lab., CA (USA)). Jan 1984. Contract AC03-76SF00098. 28p. (CONF-850105—1). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE84012254.

From ASHRAE symposium on field measurements of heat transfer in building envelopes; Chicago, IL, USA (27 Jan 1985).

Although much information is available on the steady-state thermal performance of walls in a laboratory environment, there is little information concerning either the steady-state or dynamic performance of walls in situ. This report describes a measurement apparatus, the Envelope Thermal Test Unit (ETTU), developed to measure the in situ thermal performance of walls. It includes a description of ETTU's operation, its construction, and the results of tests in the laboratory and in the field. The apparatus is described in detail, including technical specifications of the hardware. The ETTU measurements are compared with predictions made by computer simulation of the heat transfer through the test walls. These comparisons, based upon application of the Simplified Thermal Parameter theory to the interpretation of ETTU measurements, show good agreement with the computer simulations for all of the walls tested, except for the thick concrete wall. It was found that the measurements on the concrete wall were affected by large lateral heat flows.

6989 **(LBL—17459) Description of an earth contact modeling capability in the DOE-2.1B energy analysis program.** Sullivan, R.; Bull, J.; Davis, P.; Nozaki, S.; Cumali, Z. (Lawrence Berkeley Lab., CA (USA); Consultants Computation Bureau, Oakland, CA (USA)). Jun 1984. Contract AC03-76SF00098;AC03-80SF11508. 28p. (CONF-850105—3). NTIS, PC A03/MF A01; GPO Dep. File Number DE84016948.

From ASHRAE symposium on field measurements of heat transfer in building envelopes; Chicago, IL, USA (27 Jan 1985).

The problem of determining the heat transfer processes in residences and commercial structures requires accurate analytical models if one is to adequately define energy conservation measures. Various energy analysis computer simulation programs are presently available for use in the public sector. Among these programs, DOE-2.1B represents the state of the art in determining building thermal loads and energy usage quantities. However, the current version of DOE-2.1B does not rigorously deal with the problem of heat transfer in earth contact strcutures. This situation, although minor when compared with the relatively comprehensive methodology utilized for the overall energy analysis of traditional above-grade buildings, nevertheless detracts from the primary goal of a well-defined simulation. Recently, a research version of DOE-2.1B has been created with the addition of an algorithm that is used to analyze earth contact systems such as basements, crawl spaces, slabs, and berms. This paper decribes the methodology used in the DOE-2.1B program revisions and gives numerous examples regarding its applications. The mathematical technique employs the generation of a two-dimensional finite-element model form simplified user input definitions from which weekly response factors are generated for those surfaces in contact with ground. Weekly averaged weather parameters provide the external excitations used to define the thermal load within the earth contact space.

6990 **(LBL—18149) Formaldehyde and tracer gas transfer between airstreams in enthalpy-type air-to-air heat exchangers.** Fisk, W.J.; Pedersen, B.S.; Hekmat, D.; Chant, R.E.; Kaboli, H. (Lawrence Berkeley Lab., CA (USA)). Jul 1984. Contract AC03-76SF00098. 34p. (CONF-850105—2). NTIS, PC A03/MF A01; GPO Dep. File Number DE84016951.

From ASHRAE symposium on field measurements of heat transfer in building envelopes; Chicago, IL, USA (27 Jan 1985).

An experimental study is described in which the formaldehyde, tracer gas, and water vapor transfer rates in two enthalpy exchangers were measured. The first exchanger uses a cross-flow fabricated from a treated paper. The core of the second heat exchanger is a rotating heat wheel coated with lithium chloride. To reduce the transfer of gases by air leakage each core was installed in a specially fabricated case. Only 5% to 8% of the two tracer gases and 7% to 15% of the formaldehyde injected into the exhaust airstream was transferred to the supply airstream. Therefore, formaldehyde transfer between airstreams by processes other than air leakage does not seriously compromise the performance of these enthalpy exchangers. Theoretical calculations indicate, however, that the transfer of water vapor between airstreams in enthalpy exchangers can significantly diminish their ability to lower indoor formaldehyde concentrations because of the positive coupling between indoor humidity and the emission rates of formaldehyde from building materials.

6991 **(NBSIR—84-2906) Thickness effect in low-density insulation.** Burns, P.J. (Colorado State Univ., Fort Collins (USA). Dept. of Mechanical Engineering). Aug 1984. Contract AI01-76PR06010. 47p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85003065.

A discussion is presented of theory of heat transfer in low-density, glass-fiber insulation via conduction, convection, and radiation. It is concluded that the primary modes of heat transfer in this material are air conduction and radiation. An analysis of NBS data of measured apparent thermal conductivity for different thicknesses results in a parameter estimate of the optical extinction coefficient. This parameter determines the amount of change in apparent ther-

mal conductivity as a function of sample thickness. This phenomena is referred to as the thickness effect.

6992 **(NP—5770077) Practical information. Energy-conservation.** (Bundesministerium fuer Raumordnung, Bauwesen und Staedtebau, Bonn (Germany, F.R.)). 1983. 248p. (In German). NTIS (US Sales Only), PC A11/MF A01. File Number DE85770077.

Practical instructions are given for architects and draughtsmen, based on available research results. On the subject 'energy-saving'. At the same time the cross-connections are considered between energy-saving and town-planning, building-planning, building constructions and technical expansion.

6993 **(NP—5770089) Amendment to the Thermal Insulation Ordinance.** Rosemann, H. (Arbeitsgemeinschaft fuer Zeitgemaesses Bauen e.V., Kiel (Germany, F.R.)). Sep 1983. 24p. (In German). NTIS (US Sales Only), PC A02/MF A01. File Number DE85770089.

The revision of the Thermal Insulation Ordinance of 24.2.82 is aimed at reducing energy consumption and heat loss still further - not only in new buildings but also, to a limited extent, in buildings already existing. This aim is to be achieved essentially by reducing the heat transition coefficients, k, in tables 1 and 2, of system 1 by approximately 25% and of system 3 on average by 6%. The latter are buildings with low interior temperatures. The methods employed up until now for checking the thermal insulation of buildings with normal indoor temperatures have been preserved, ie. both the checks for calculating heat transition. The main changes are as follows: The heat transition coefficient of exterior windows and doors of heated rooms was reduced to 3.1 $W/m^2K$. The restriction of heat transition with regard to constructional changes to existing buildings. To conclude it can be seen that the present level of heat insulation requirements correspond to the current requirements of energy policy, is in line with the present potential of structural engineering and the building trade and creates favourable conditions for developing further building, which takes due regard to energy conservation.

6994 **(ORNL/CON—150) Air-source heat pump: field measurement of cycling, frosting, and defrosting losses, 1981-1983.** Baxter, V.D.; Moyers, J.C. (Oak Ridge National Lab., TN (USA)). Nov 1984. Contract AC05-84OR21400. 113p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE85003609.

An air-to-air heat pump was installed in a single-family residence near Knoxville, Tennessee, and was operated in a multiyear test to permit characterization of dynamic losses in capacity and efficiency due to cycling, frosting, and defrosting. The residence and heat pump were extensively instrumented, and a state-of-the-art data acquisition system logged data for each of the several system operating modes (start-up transient heating and cooling, normal-mode heating and cooling, and defrost with recovery) throughout the testing period. For the test heating seasons, defrosting was responsible for 10.1%, losses due to frosting for 3.6%, on-off cycling losses for 8.4%, and off-cycle parasitic for 4.3% of the total energy consumption (exclusive of supplemental electric resistance heater energy use as required by second-stage thermostat demand). An overall heating seasonal performance factor of 1.96 was realized, and the value of the cyclic degradation factor, C/sub d/, in heating was found to be 0.24. Both output loss per cycle and input energy increase per cycle were directly related to off-time per cycle, increasing strongly with off-times up to approximately 20 min and at a much lower rate thereafter. Defrost time per defrost cycle and the associated energy use penalty varied directly with frosting potential; the effect of ambient temperature on defrost time is not clear, and additional investigation is warranted. Use of a desuperheater for domestic water heating reduced the heat pump's space heating capacity but had no measurable effect on dynamic loss levels. The steady-state cooling capacity and coefficient of performance (COP) of the heat pump were degraded from the manufacturer's ratings and those which were measured in initial steady-state tests, precluding definitive evaluation of dynamic losses during cooling operation. The cyclic degradation factor, C/sub d/, in cooling was estimated to be between 0.20 and 0.25.

6995 **(ORNL/CON—161) Conservation potentials, participation, and retrofit choices in the Connecticut Residential Conservation Service (CONN SAVE) program.** Tonn, B.; Berry, L. (Oak Ridge National Lab., TN (USA)). Nov 1984. Contract AC05-84OR21400. 81p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85003634.

The distribution of technical potentials among dwellings in the data set is examined. Audit findings on potential savings and costs are reported across house types, house ages, primary heating fuels, household incomes and education, and years in current residence. Regression and cluster analysis results are also presented. Information on participation behavior is presented. Characteristics of participant and nonparticipant groups are described. In addition, qualitative choice models (using logistic procedures) are developed as tools to predict participation in the CONN SAVE program. Models of retrofit decision making are developed. In this analysis, efforts are made to characterize the decision making process used by CONN SAVE participants to chose which measures to install or not to install. Findings about technical potentials and about participation and retrofit choice behaviors are summarized and discussed. The implications for CONN SAVE program management and for future data collection and analysis efforts also are reviewed.

6996 **(ORNL/Sub—82-17485/1) Development and demonstration of a Stirling/Rankine Heat Activated Heat Pump. Phase IIIB. Engine technology development testing. Final report.** (General Electric Co., Philadelphia, PA (USA). Advanced Energy Programs Dept.). Nov 1984. Contract AC05-84OR21400. 203p. NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE85004388.

This report presents the results of the Phase IIIB Stirling/Rankine Heat Activated Heat Pump product development program. Results of the Phase II program indicated deficiencies in the performance of the free-piston Stirling engine and mismatching of the dynamic characteristics of the engine and the compressor. These deficiencies were further investigated during in-depth diagnostic testing of the engine/compressor unit in the Phase IIIB program. Results of these tests identified the engine design deficiencies and indicated appropriate engine/compressor matching criteria. The Phase IIIB results are presented.

6997 **(PB—84-217918) Effectiveness of solar shading for an office building. Final report.** Treado, S.; Barnett, J.; Remmert, W. (National Bureau of Standards, Washington, DC (USA). Center for Building Technology). May 1984. 115p. NTIS, PC A06/MF A01.

Also available from Supt. of Docs as SN003-003-02584-4. Library of Congress catalog card No. 84-601038. Sponsored in part by General Services Administration, Washington, DC, Naval Facilities Engineering Command, Alexandria, VA, Directorate of Civil Engineering (Air Force), Washington, DC and Office of the Chief of Engineers (Army), Washington, DC.

The impact of solar shading of windows on building energy consumption, energy costs and occupant comfort is examined for a typical office building. Measurements of the solar and thermal performance characteristics of three solar screens are reported. Using the DOE-2 computer program, annual building energy simulations were performed for seven climatic locations in the United States. Thirteen combinations of window thermal transmittance and shading coefficient are examined for each location. The analysis includes separate evaluations for buildings with all-year cooling and summer-only cooling. The results indicate that solar shading can reduce building energy consumption and improve comfort conditions in buildings with significant cooling loads. The optimum shading device characteristics vary with climatic location.

6998 **(PB—84-218064) National Voluntary Laboratory Accreditation Program proficiency testing for Thermal Insulation Materials Laboratory Accreditation Program Round 9 - August 1983. Final report.** Horlick, J. (National Bureau of Standards, Washington, DC (USA). Office of Product Standards Policy). Jun 1984. 21p. (NBSIR—84/2890). NTIS, PC A02/MF A01.

The National Voluntary Laboratory Accreditation Program (NVLAP) is a federal program which accredits testing laboratories

satisfying published criteria. One Laboratory Accreditation Program (LAP) accredits laboratories for thermal insulation materials test methods. Participation in proficiency testing is required for certain test methods including: settled density, smoldering combustion, surface flammability, and thermal conductivity. Analyses and summaries of the test data returned by 30 laboratories for these methods for Insulation LAP Proficiency Testing Round 9 are reported. A description of NVLAP proficiency testing and how it fits into the laboratory evaluation process is given.

6999 **(PB—84-221985) Effective use of daylighting. Final report.** Treado, S.J.; Gillette, G.L. (National Bureau of Standards, Washington, DC (USA)). Jun 1983. 9p. Pub. in Proceedings of the Energy Technol. Conf. (10th), Washington, DC, 28 February-2 March 1983, p647-655 June 1983.

The type, size and configuration of fenestration apertures have a strong impact on building lighting, heating and cooling loads. Daylight utilization has been shown to have good potential for reducing lighting energy requirements; however, the effect of daylighting schemes on building space heating and cooling energy requirements must also be considered. Since the luminous efficacy of solar radiation is typically two or three times that of electric light sources, the substitution of the proper levels of daylight for electric lighting can reduce lighting and cooling loads substantially, while providing the additional psychological and aesthetic benefits traditionally associated with fenestration in buildings. This paper describes some of the results obtained from measurements and computer simulations regarding the optimum utilization of daylight in buildings. The findings are summarized in the form of design guidelines for effective fenestration utilization.

7000 **(PB—84-222249) Building technology project summaries, 1983-1984 (of the National Bureau of Standards (NEL) Center for Building Technology). Final report.** Raufaste, N.J.; Olmert, M. (National Bureau of Standards, Washington, DC (USA). Center for Building Technology). Jun 1984. 141p. (NBS/SP—446-8). NTIS, PC A07/MF A01.

See also PB83-259622.

The Center for Building Technology (CBT) of the National Bureau of Standards (NBS) is the national building research laboratory. It works cooperatively with other organizations, private and public, to improve building practices. It conducts laboratory, field, and analytical research. It develops technologies to predict, measure, and test the performance of building materials, components, systems, and practices. This knowledge is required for responsible and cost-effective decisions in the building process and cannot be obtained through proprietary research and development. CBT provides technologies needed by the building community to achieve the benefits of advanced computation and automation. CBT does not promulgate building standards or regulations, but its technologies are widely used in the building industry and adopted by governmental and private organizations that have standards and codes responsibilities. CBT programs include: computer-integrated construction, structural safety, earthquake hazards reduction, building physics, building equipment, quality of building materials, and cement hydration.

7001 **(PB—84-225226) Approach to optimization of low-power Stirling cryocoolers. Final report.** Sullivan, D.B.; Radebaugh, R.; Daney, D.E.; Zimmerman, J.E. (National Bureau of Standards, Washington, DC (USA)). 1983. 24p. Pub. in Proceedings of Biennial Conference Refrigeration Cryogenic Sensors Electronic Systems (2nd), Greenbelt, MD, December 7-8, 1982, p107-130 1983.

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The authors describe a method for optimizing the design (shape of the displacer) of low-power Stirling cryocoolers relative to the power required to operate the systems. A variational calculation which includes static conduction, shuttle, and radiation losses, as well as regenerator inefficiency, has been completed for coolers operating in the 300 K to 10 K range. While the calculations apply to tapered displacer machines, comparison of the results with stepped-displacer cryocoolers indicates reasonable agreement.

7002 **(PB—84-232172) Preheat prediction models.** Florez, J.; Barney, G.C. (Manchester Univ. (UK). Inst. of Science and Technology). Jan 1984. 41p. NTIS, PC E04/MF E04.

Using semiempirically derived relationships between the time required to preheat the building before occupancy, and the measured temperatures, self-tuning optimum start controllers are developed, based on an adaptive predictor. Results obtained from simulations show that these controllers, and their variants, behave well and have superior performance characteristics compared with a conventional self-learning start-up controller. The controllers proposed assume no prior knowledge of the thermal characteristics of the building and are suitable for low-cost microcomputer implementation.

7003 **(PB—84-232404) Modelling the short wave, long-wave and convective heat transfer at glazing surfaces for the detailed computation of the thermal performance of unshuttered and shuttered windows.** Sharples, S. (Sheffield Univ. (UK). Dept. of Building Science). Sep 1980. 33p. (BS—54). NTIS, PC E04/MF E04.

The paper starts with a discussion of the shortcomings of the shading coefficient technique for estimating the energy balance of a glazing system. Its accuracy and flexibility are considered. The theoretical background of an improved computer-based model developed to replace the shading coefficient method is then described. The new method is quasi steady-state in nature, but allows the hour-by-hour variations in glass temperature and energy flow, resulting from continuously changing external and internal environmental conditions, to be assessed. Full account is taken of glazing transmission properties and surface emittances. The model is designed to run in conjunction with the University of Sheffield meteorological data input system. The external climatic parameters are separately modelled for three different classes of day representing clear days, average days and overcast days for any location within the United Kingdom. Input and output data for glazing of any orientation and inclination can be generated.

7004 **(PB—84-232842) Guide to energy prediction and use in buildings.** Ward, I.C. (Sheffield Univ. (UK). Dept. of Building Science). Mar 1983. 89p. (BS—72). NTIS, PC E05/MF E05.

This document attempts to outline the various aspects of building heat transfer and goes on to consider methods of energy conservation within the building fabric.

7005 **(PB—84-233600) Development of an interactive computer program for analysing the thermal performance of buildings.** Thompson, J.L.; Rodgers, G.G. (Sheffield Univ. (UK). Dept. of Building Science). Mar 1984. 38p. (BS—76). NTIS, PC E04/MF E04.

The energy situation of today has led to much research activity in many areas of energy conservation. One such area is the modelling of the thermal performance of buildings. Numerous computer based models have been developed. These models can be categorized as either steady state models or dynamic models. The steady state models are mathematically simple and require relatively little information to describe a given building. The dynamic models provide detailed information on the dynamic thermal response of buildings. Two distinct approaches have been adopted in the development of these models. Some are based on finite difference techniques, others use the response factor technique. Dynamic models can provide information on the short-term thermal response of buildings, at time intervals of, for example, one hour. At Sheffield a steady state program, ENGY, has been developed which is based on a variable degree-day base temperature approach. The program is fully interactive and the original version was mounted on a mainframe computer with multiple access from either graphics or alphanumeric terminals. The program is currently being converted for use on a micro-computer, with a view to making it more widely available commercially.

7006 **(PB—84-236215) BRE (Building Research Establishment) low-energy office.** Crisp, V.H.C.; Fisk, D.J.; Salvidge, A.C. (Building Research Establishment, Watford (UK)). 1984. 72p. NTIS, PC E04/MF E04.

Sponsored in part by UKAEA Atomic Energy Research Establishment, Harwell (England).

This paper reports the results of monitoring the energy performance of the BRE the low-energy office. It is intended to provide important feedback to designers of today's buildings needing to meet the requirements of the new Building Regulations. It is also intended to demonstrate the efficacy of using at the earliest design stages the new aids for designers, such as the CIBS Energy Code. At the same time feedback on design-aid performance is provided for consideration for future improvement. The monitoring exercise was funded by the Department of Energy under the Energy Conservation Demonstration Projects Scheme. A low-energy building can only be the result of the contribution from all of the skills of the construction industry. The report is structured as far as possible to meet this audience of diverse interests. Following the description of the building's design, its monitored performance is summarized in terms of its 'energy management' statistics. Finally, the conclusion summarizes the lessons learned from the monitoring results that would be relevant to improving the energy performance of a building on the drawing boards in today's design offices.

7007 **(PB—84-237726) Natural gas I. C. (internal combustion) engine heat pump study. Final report June 1981-September 1982.** Shelton, S.V. (Georgia Inst. of Tech., Atlanta (USA). School of Mechanical Engineering). Apr 1983. 92p. (E—25/650). NTIS, PC A05/MF A01.

The internal combustion engine heat pump is one gas heat pump technology which uses existing component technology; it therefore offers the possibility of early development of a commercially viable gas heat pump. In order to assess the development barriers, this project carried out field tests on an I.C. engine heat pump providing heating and cooling to a residence over two heating and two cooling seasons. Experimental results showed steady state and seasonal heating coefficients of performance (COP) of 1.4 to 1.5 with cooling COP's 0.5 to 0.6. These efficiencies were in spite of the low 16% efficiency of the 1600 cc four cylinder industrial engine due to being loaded only to about 25%. Using experimental engine/compressor data in conjunction with an air-to-air heat pump system configuration model, seasonal heating COP's of 1.33, 1.45, and 1.53 were predicted for Chicago, Atlanta, and Orlando respectively. Cooling COP's were 0.73 in all three cities. Higher engine loading would improve all COP's. No maintenance was required for the 2400 hours of operation during two heating and two cooling seasons. Noise in the equipment room was 63 dB with 61 dB measured outside next to the exhaust outlet.

7008 **(PB—84-237734) Efficiency and emissions improvement of gas-fired space heaters. Task 2. Unvented space heater emission reduction. Final report February-August 1983.** Zawacki, T.S.; Cole, J.T.; Huang, V.M.S.; Banasiuk, H.; Macriss, R.A. (Institute of Gas Technology, Chicago, IL (USA)). Jun 1984. 41p. NTIS, PC A03/MF A01.

See also PB84-179761.

The intent of this study was to investigate simple methods of reducing emissions, specifically NOx, in a typical unvented space heater. The basic design was to be retained, and changes limited to minor modifications to achieve the desired results. In this respect, it was determined that a significant reduction in the NOx levels was possible by relatively simple applications of appropriate burner inserts. However, GRI has been reviewing indoor air quality and has, subsequent to the completion of this work, added emphasis on the reduction of NO2 as well as NOx. In this light, the suitability of some of the reported techniques is questionable.

7009 **(PB—84-237767) Free-piston Stirling engine development. Annual report 1 December 1982-31 December 1983.** Marusak, T.J.; Gilles, T. (Mechanical Technology, Inc., Latham, NY (USA)). Apr 1984. 131p. (MTI—84FPSE23). NTIS, PC A07/MF A01.

The FPSE is an important prime mover option in developing a viable gas-fueled heat pump for residential applications. The Stirling engine, while potentially attractive from a performance, life, and cost standpoint, is on a long-term development track. The reported results show that progress has been made in improving engine performance and reliability. The engine development is being funded by the Gas Research Institute, with the main technical goal of integrating the most advanced, reliable system components into a prototype FPSE heat pump module for laboratory testing and evaluation. Development of the compressor for the FPSE-driven heat pump is being supported by a coordinated and parallel DOE-sponsored program.

7010 **(PNL—4951) Natural ventilation: it's as easy as opening the windows, or is it.** Siebein, G.W. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1984. Contract AC06-76RL01830. 50p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85003883.

The research consisted of an evaluation of the existing technologies available for passive cooling with an emphasis on strategies related to the use of natural ventilation. A preliminary data base for the study was established by three major efforts: 1. An extensive literature search of the architectural press was undertaken to ascertain the degree to which passive cooling strategies in general and natural ventilation in particular are designed into buildings at the present time. 2. An investigation of existing building stock profiles was undertaken to identify the existing and potential obstacles or advantages to the implementation of natural ventilation as a passive cooling strategy. The EIA Nonresidential Buildings Energy Consumption Survey and two previous PNL studies were reviewed. 3. Components 1 and 2 were followed up with telephone interviews and site visits with the architects, building owners and operators of selected buildings from 1 and 2 above to gain more specific insights into the problems and pleasures typically associated with natural ventilation.

7011 **(RAND-P—6684) Energy and the existing stock of housing.** Neels, J.K.; Murray, M.P. (RAND Corp., Santa Monica, CA (USA)). Dec 1982. 63p. Rand Corp., 1700 Main St., Santa Monica, CA 90406. File Number TI85900397.

Recent engineering studies of residential energy use are reviewed with an eye toward assessing what can be done to reduce energy requirements. The burdens that rising energy prices will place on consumers of housing are discussed. The impacts of rising energy prices on the owners of the existing housing stock are studied. The policy implications of the findings are discussed. (MHR)

7012 **Absorption heat pump system.** Grossman, G. (to Dept. of Energy). US Patent 4,458,499. 10 Jul 1984. Filed date 16 Jun 1982. vp.

PAT-APPL-388874.

The efficiency of an absorption heat pump system is improved by conducting liquid from a second stage evaporator thereof to an auxiliary heat exchanger positioned downstream of a primary heat exchanger in the desorber of the system.

7013 **Absorption heat pump system.** Grossman, G.; Perez-Blanco, H. (to Dept. of Energy). US Patent 4,458,500. 10 Jul 1984. Filed date 16 Jun 1982. vp.

PAT-APPL-388875.

An improvement in an absorption heat pump cycle is obtained by adding adiabatic absorption and desorption steps to the absorber and desorber of the system. The adiabatic processes make it possible to obtain the highest temperature in the absorber before any heat is removed from it and the lowest temperature in the desorber before heat is added to it, allowing for efficient utilization of the thermodynamic availability of the heat supply stream. The improved system can operate with a larger difference between high and low working fluid concentrations, less circulation losses, and more efficient heat exchange than a conventional system.

7014 **Energy in American homes: changes and prospects.** Meyers, S.; Schipper, L. (Energy Analysis Program, Lawrence Berkeley Laboratory, University of California, Berkeley, CA). *Energy (Oxford);* 9: No. 6, 495-504(Jun 1984).

Average energy consumption per U.S. household has fallen by just under 20% in the last ten years. Much of this drop occurred

after 1979, when gas and electricity prices as well as oil prices rose in real terms. The response of households to higher prices has involved physical modifications on and in the home and changes in behavior. Many actions have been taken by households, but the most important single factor has been a significant reduction in indoor temperatures. The greater energy efficiency of new homes and appliances has also helped to depress residential energy demand, although improvements have levelled off in the last few years. There are signs that the momentum of energy conservation is less now than it was 2 years ago, but it appears that energy prices will be high enough to discourage households from returning to former energy-using practices. Along with the continued replacement of homes and appliances with more efficient models, and other factors such as the migration to warmer regions and the movement to more apartments and smaller homes, this will probably keep U.S. residential energy consumption at about its present level through the 1980s.

7015 **The reference building--one approach in the evolution of building energy performance criteria for houses.** Heldenbrand, J.L.; Petersen, S.R. (Center for Building Technology, National Bureau of Standards, Washington, DC). *ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) Transactions;* **88**: 387-400(Dec 1982). (CONF-820112—).

From Semi-annual meeting of the American Society of Heating, Refrigerating, and Air Conditioning Engineers; Houston, TX, USA (24 Jan 1982).

The reference building approach described in this paper was introduced in the context of the National Bureau of Standards support for the building energy conservation criteria program of the Office of Buildings and Community Systems, U.S. Department of Energy. The role of NBS is to develop technical data and methods for design, construction, and retrofitting of energy efficient buildings. Recent federal initiatives to regulate energy use at the design stage of new buildings support the broadening of performance standards to the whole-building level. A logical means of developing such standards is to provide a methodology for linking component performance standards to the whole-building design-energy-performance level. A side benefit of such a methodology is the assurance that these two paths to building design are consistent and complementary. The "Reference Building Approach" (RBA) reported here is one such method. As described here, the RBA approach is not a complete package suitable as a substitute for the Department of Energy's proposed Building Energy Performance Standards (BEPS). However, the paper deals with an element of BEPS and offers a possible improvement to it.

7016 **Annual Cycle Energy System performance and national economic comparisons with competitive residential HVAC systems.** Baxter, V.D.; Abbatiello, L.A.; Nephew, E.A. (Oak Ridge National Lab, Oak Ridge, TN). *ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) Transactions;* **88**: 1279-1296(Jun 1982). (CONF-820112—).

From Semi-annual meeting of the American Society of Heating, Refrigerating, and Air Conditioning Engineers; Houston, TX, USA (24 Jan 1982).

The Annual Cycle Energy System (ACES) project, sponsored by the U.S. Department of Energy, provides a technology that helps meet the demand for electrically based heating and cooling at substantially higher efficiencies than are obtainable with alternate systems. The ACES provides space heating, air conditioning, and domestic water heating to residences and commercial buildings through the use of an electrically driven unidirectional heat pump that obtains its heat from water stored in an insulated underground tank. As the heat is extracted during the heating season, most of the water is frozen and the stored ice provides air conditioning in the summer, or at other times if needed. Thus, the water's heat of fusion is available as a heat source in winter and as a heat sink during periods of cooling needs. Because both the heating and cooling outputs of the heat pump are used, the resulting annual coefficient of performance (ACOP) is high.

7017 **Design guidelines for spot cooling systems: Part 1. Assessing the acceptability of the environment.** Azer, N.Z. (Kansas State Univ., Manhattan, KS). *ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) Transactions;* **88**: 81-96(Jan 1982). (CONF-820112—).

From Semi-annual meeting of the American Society of Heating, Refrigerating, and Air Conditioning Engineers; Houston, TX, USA (24 Jan 1982).

The procedure for designing a total volume air-conditioning system is well documented in ASHRAE literature; however, there are deficiencies and a lack of basic information available to designers of stratified and spot cooling systems. This paper deals with the design of spot cooling systems. Its objective is to identify the basic information needed for the design process. It also discusses how such information can be used with the ultimate objective of designing the spot cooling system with minimum energy usage.

7018 **Design guidelines for spot cooling systems: Part 2. Cooling jet-model and design procedure.** Azer, N.Z. (Kansas State Univ., Manhattan, KS). *ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) Transactions;* **88**: 97-116(Jan 1982). (CONF-820112—).

From Semi-annual meeting of the American Society of Heating, Refrigerating, and Air Conditioning Engineers; Houston, TX, USA (24 Jan 1982).

In part one of this paper, it was pointed out that a knowledge of the cooling jet performance is required to allow the designer of the spot cooling system to integrate the jet properties at its outlet (D /SUB o/ , V /SUB o/ , T /SUB o/ and P /SUB o/ or rh /SUB o/ ) with the air properties of the industrial environment (T /SUB A/ and P /SUB A/ or rh /SUB A/ ) and predict the average air properties (V /SUB j/ , T /SUB j/ , and P /SUB j/ or rh /SUB j/ ) at the target area to which the worker will be exposed. Also in part one, a procedure was presented that allows the designer to identify different combinations of V /SUB j/ , T /SUB j/ and P /SUB j/ that can result in the same degree of acceptable physiological strain. In this second part of the paper, a jet model is identified and a step-by-step procedure is outlined for integrating the information in part one with the jet model to design the spot cooling system. Several case studies using the proposed design procedure also are presented.

7019 **Conceptual design and performance analysis of absorption heat pumps for waste heat utilization.** Grossman, G.; Perez-Blanco, H. (Oak Ridge National Laboratory, Oak Ridge, TN). *ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) Transactions;* **88**: 451-466(Jan 1982). (CONF-820112—).

From Semi-annual meeting of the American Society of Heating, Refrigerating, and Air Conditioning Engineers; Houston, TX, USA (24 Jan 1982).

A thermodynamic analysis of an absorption heat pump cycle has been performed. The system operates on low-grade heat, with only a small input of electrical energy for auxiliary equipment. This feature alone makes it extremely attractive from the standpoint of energy conservation. The actual design of the system should attempt to minimize the parasitic power required for operation. Two working materials, LiBr-water and LiCl-water, have been considered. The combination LiBr-water offers the important advantage over LiCl-water of achieving a higher temperature boost. This consideration may make LiBr solutions the preferred working fluid. The analysis of the absorber/evaporator system indicates that in order to maximize the temperature boost, it is necessary to operate at high values of the low concentration (C /SUB L/ ), with a relatively small concentration change (C /SUB H/ - C /SUB L/ ). A small concentration change, however, is undesirable, as it tends to increase circulation losses. In an actual design, it becomes necessary to trade off a high temperature boost for a lower COP. The absorber/evaporator performance maps presented in this paper are a useful guide in selecting practical operational conditions that can be met without increasing the parasitic power requirements beyond reasonable limits.

7020 **The determination of the dynamic performance of walls.** Sherman, M.H.; Adams, J.W.; Sondergger, R.C. (Lawrence Berkeley Lab., Berkeley, CA). *ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) Transactions;* **88**: 689-712(Jan 1982). (CONF-820112—).

From Semi-annual meeting of the American Society of Heating, Refrigerating, and Air Conditioning Engineers; Houston, TX, USA (24 Jan 1982).

The thermal performance of building walls, in situ, is largely unknown. Until now, most wall performance measurements have been done in laboratories, typically by using large hot-boxes. In-situ performance is considerably more difficult to measure, for the experimenter usually has little control over temperature, solar radiation, or wind conditions. The task of accurately measuring surface temperatures and heat fluxes over significant lengths of time is not easy. Furthermore, once measurements have been obtained analysis of the data is not a trivial matter. As illustrated by a review of measurement techniques and wall performance models compiled by Carroll, most existing models contain too many parameters to be suitable for direct analysis. A simplified model of dynamic thermal performance that allows the characteristics of a wall to be quantified on the basis of measured surface temperatures and heat fluxes has been developed. The model uses a set of simplified thermal parameters (STPs) to characterize the thermal performance of walls from an arbitrary temperature history. In addition, the STPs can be used to arrive at a physical interpretation of the behavior of a wall. This model is applicable to any set of data. In this report, however, its application to the analysis of data collected by the Envelope Thermal Test Unit (ETTU), is demonstrated. Accordingly, laboratory meaurements using ETTU are included as part of the validation procedure.

7021 **A predictive air infiltration model-long-term field test validation.** Grimsrud, D.T.; Modera, M.P.; Sherman, M.H. (Energy Performance of Buildings Group, Lawrence Berkeley Laboratory, Univ. of California, Berkeley). *ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) Transactions;* **88**: 1351-1372(Jan 1982). (CONF-820112—).

From Semi-annual meeting of the American Society of Heating, Refrigerating, and Air Conditioning Engineers; Houston, TX, USA (24 Jan 1982).

Researchers at a national laboratory have developed a model that can be used to predict the air infiltration rate of a residential structure. This model uses wind speed and outdoor temperature data, along with selected building and site parameters, to predict either hour-by-hour or long-term average infiltration. Until now, the validity of the model has been tested through short-term survey measurements in occupied houses. Although the correlations of predicted and measured infiltration have been good, tests in occupied houses are necessarily restricted in terms of the time spent at any given house and the control of the model parameters for each building and site. This report presents long-term field validation results obtained by means of a portable test structure, the Mobile Infiltration Test Unit. In addition, long-term data from three unoccupied test houses at another research center are used to compare model predictions with measured infiltration data.

7022 **Sampling for air exchange: Rates in a variety of buildings.** Hurrje, D.T.; Gadsby, K.; Linteris, G. (Center for Energy and Environmental Studies, Princeton Univ., Princeton, NJ). *ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) Transactions;* **88**: 1373-1384(Jan 1982). (CONF-820112—).

From Semi-annual meeting of the American Society of Heating, Refrigerating, and Air Conditioning Engineers; Houston, TX, USA (24 Jan 1982).

Bottle sampling of the tracer-gas concentration shows considerable promise as an accurate, inexpensive way to measure air infiltration rates in a wide variety of buildings. A major advantage is that inexpensive flexible plastic bottles can be pumped to collect the samples and reused tens of times. The laboratory analysis procedures have been perfected to reduce data scatter to a minimum. For single family homes, the sampling procedure is simple enough so that homeowners can easily take the sample and then send them to the laboratory for routine analysis. In centrally conditioned buildings, sampling in the air ducts confirms that the container method is applicable, even to the more complex buildings, provided certain guidelines are followed.

7023 **Residential water heating: What's best for you?.** Ballou, M.L. (Oak Ridge National Lab., TN). *ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) Transactions;* **88**: 575-584(Jan 1982). (CONF-820112—).

From Semi-annual meeting of the American Society of Heating, Refrigerating, and Air Conditioning Engineers; Houston, TX, USA (24 Jan 1982).

Today's residential consumer can select water heating options which result in large electrical energy savings. The homeowner using a desuperheater water heater system should expect effective annual water heating COPs which range from 1.3 for northern cities to 2.9 in southern cities. The average consumer could expect to save between 800 and 2500 kWh/yr with a desuperheater if he is presently heating water with a conventional electric water heater. A HPWH within the thermal envelope of an air-to-air heat pumped home would yield similar savings. Even though the consumer can achieve significant energy savings, these savings may not translate into significantly different life cycle economics. The major economic conclusions of this study are: The desuperheater water heater can save a significant amount of energy at attractive life-cycle costs and acceptable first costs if the owner is choosing between electrically powered alternatives; The HPWH located within the thermal envelope of the air-to-air heat pump heated house offers slightly better life-cycle costs than does the desuperheater system; Water heating with natural gas offers the most favorable life-cycle costs of all alternatives considered in this study and is nearly the lowest first-cost system; Installation of a HPWH within the thermal envelope of an all-electric home may or may not offer a favorable life-cycle alternative, depending in large part upon how much air conditioning is normally done in that house.

7024 **The effect of location on the predicted performance of a heat pump water heater.** Levins, W.P. (Energy Division, Oak Ridge National Laboratory, Oak Ridge, TN). *ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) Transactions;* **88**: 585-596(Jan 1982). (CONF-820112—).

From Semi-annual meeting of the American Society of Heating, Refrigerating, and Air Conditioning Engineers; Houston, TX, USA (24 Jan 1982).

Laboratory testing and field testing have shown that a heat pump water heater (HPWH) uses about half the electrical energy input that an electric resistance water heater does. However, since the HPWH extracts energy from the air in its environment, the question arises as to how this energy extraction would affect the house heating, ventilating, and air-conditioning (HVAC) system if the HPWH were located in a conditioned space of a household. A second question concerns the savings obtained by locating the HPWH in an unconditioned space such as a garage or basement. The effect of locating the HPWH in the conditioned spaces of houses with a high-performance heat pump as well as resistance-gas- and oil-heated houses with a high performance electric air conditioner was studied. All calculations were made on a desktop computer. Weather bin data and inlet water temperatures for each city were used to calcuate the energy consumption for the house first with a resistance water heater, and then with a HPWH. The difference between these values was used to calculate the performance factor (PF) of the HPWH. The HPWH will add to the house heating load in winter and lessen the house cooling load in summer.

7025 **Heat pump water heaters with a comparison to solar domestic water heaters.** Claridge, D.E. (Solar Energy Research Inst. Golden, CO). *ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) Transactions;* **88**: 597-602(Jan 1982). (CONF-820112—).

From Semi-annual meeting of the American Society of Heating, Refrigerating, and Air Conditioning Engineers; Houston, TX, USA (24 Jan 1982).

A heat pump water heater (HPWH) is a conservation water heating system for new and retrofit residential and commercial applications. There are two generic types of HPWHs: a stand-alone

appliance-type heat pump unit plumbed to a conventional water tank, and an integral heat pump/water tank unit with the heat pump installed on top of the tank. Both types are installed independently of the space conditioning equipment. In each case, the heat pump draws in air, extracts heat from it, and uses this to heat the tank water. A byproduct of the system is cool, dehumidified air discharge. Depending on the season of the year, the geographical area, and the building location of the HPWH, the overall system efficiency is increased or decreased by cooling effects on the space-conditioning load. Since HPWHs do not operate below 7°C (45 F) and have no freeze protection, the preferred installation location is an unconditioned building space, such as a basement, crawl space, or utility room. HPWHs have become commercially available in the past year and cost under $1,000 installed. At least manufacturers plan to market HPWHs within the next 6 to 12 months.

7026 **Energy-conserving retrofits and indoor air quality in residential housing.** Hollowell, C.D.; Berk, J.V.; Brown, S.R.; Young, R.A. (Building Ventilation and Indoor Air Quality Program, Lawrence Berkeley Laboratory, University of California, Berkeley, CA). *ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) Transactions;* **88**: 875-894(Jan 1982). (CONF-820112—).

From Semi-annual meeting of the American Society of Heating, Refrigerating, and Air Conditioning Engineers; Houston, TX, USA (24 Jan 1982).

The impact on indoor air quality by a utility's weatherization program appears to be minimal. There was no significant change in either leakage area or pollutant concentrations before and after the retrofit. No pollutants, however, reached levels approaching health guidelines or standards. On the one hand, it may be concluded that such retrofit programs improve the thermal integrity of houses and can probably continue without fear of significantly increasing indoor air pollution. On the other hand, the potential for reducing air leakage has not been fully realized. Leakage in the ductwork was rather high in this study. In many parts of the country, ductwork in houses is contained within conditioned spaces where leakage will have little effect. In areas where the ductwork enters unconditioned spaces, the possibility of leakage in the ducts should be fully investigated in weatherization programs. In addition, builders and subcontractors should be alerted to the importance of properly installing ductwork, for it is clearly easier to prevent leaks during construction than in later retrofit procedures. The Cranbury, NJ, house had received extensive and careful retrofit work, and the cost-effectiveness of a house doctor or super-retrofit afterwards is questionable. In addition, the house was not monitored under conditions of full daily occupancy. Nevertheless, the study was a useful demonstration that a conventional, older home can be successfully tightened by careful weatherization and renovation. In this case, the work was accomplished without adverse effects on the air quality indoors.

7027 **The impact of ventilation rates on the design of office buildings.** Ross, H.; Birdsall, B.; Goodman, M. (Dept. of Energy, Office of Building Energy Research and Development). *ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) Transactions;* **88**: 915-928(Jan 1982). (CONF-820112—).

From Semi-annual meeting of the American Society of Heating, Refrigerating, and Air Conditioning Engineers; Houston, TX, USA (24 Jan 1982).

ASHRAE recently updated its ventilation standard, 62-73 (now 62-81). In its updated version, the minimum and recommended ventilation rates have been deleted; instead, ventilation levels have been proposed for nonsmoking and smoking environments, with the latter requiring four to five times the rate of ventilation air. A study was conducted to determine the impact of different ventilation rates on office building energy use, first cost, and peak electrical demand. Also studied was the effectiveness of a variety of design strategies for mitigating the impacts. The study was conducted by simulating with the DOE-2.1 computer program[2] an energy-efficient office building in five cities. The cities were selected because of their growing metropolitan populations and new commercial construction.

7028 **Technical opportunities for energy efficient buildings, a least-cost scenario, 1980-2000.** Rosenfeld, A.H.; Claridge, D. (Lawrence Berkeley Lab.). pp 1504-1[illegible]2 of Proceedings of the 1981 International Gas Research Conference. Rockville, MD, USA; Government Institutes, Inc. (1982). (CONF-810909—).

From International gas research conference; Los Angeles, CA, USA (28 Sep 1981).

A long history of cheap energy has left the US with a stock of buildings that use more energy than is optimal for today's or tomorrow's energy prices. The Solar Energy Research Institute (SERI) and the Lawrence Berkeley Laboratory (LBL) carried out a study to investigate how much energy might be saved by cost-effective conservation and solar measures. One of the study's conclusions was that by 2000 AD building energy consumption would be reduced to 18 EJ from a conventional projection of 32 EJ if all measures cost-effective at today's energy prices were implemented. Renewable sources of energy could provide an additional 2.5 EJ. To achieve this potential $425 billion would be invested over the next twenty years. This investment would supply extremely cheap energy; for example, the residential energy saved costs 2.1 cents per kWh, and $2.9 per GJ.

7029 **Development of a high-efficiency warm air furnace using heat pipes.** Ernst, D.M.; Eastman, G.Y. (Thermacore, Inc.). pp 1371-1379 of Proceedings of the 1981 International Gas Research Conference. Rockville, MD, USA; Government Institutes, Inc. (1982). (CONF-810909—).

From International gas research conference; Los Angeles, CA, USA (28 Sep 1981).

The residential sector consumes $1.2 \times 10^{12}$ MJ (11.3 quads) of energy annually. Of this $5.2 \times 10^{11}$ MJ (4.9 quads) come from natural gas. An increase in the annual operating efficiency of the gas fired warm air furnace from the current 65-75% level to the 85-90% range could, when fully implemented, conserve up to $1 \times 10^{11}$ MJ (1 quad) of energy annually. This paper covers the development of such a furnace. An assessment of the current and projected mid 1980's furnace market is presented which, when coupled with the Federal Regulations for fuel efficient appliances and environmental considerations, provided a means for selecting a furnace size, capacity and efficiency. Several design concepts and prototype models are discussed along with operational data and evaluation. The current phase of the program concluded with in the delivery of a 88% efficient furnace to Brookhaven National Laboratory.

7030 **Analysis of combined solar/gas technologies for residential heating and cooling.** Maas, S.; Jacobsen, A. (Booz, Allen and Hamilton Inc., Energy and Environment Division). pp 1321-1332 of Proceedings of the 1981 International Gas Research Conference. Rockville, MD, USA; Government Institutes, Inc. (1982). (CONF-810909—).

From International gas research conference; Los Angeles, CA, USA (28 Sep 1981).

This paper quantifies and projects overall performance and energy costs for residential combined solar/gas systems through the year 2000. Integrated solar/gas technologies being developed by both DOE and the gas industry are characterized and evaluated. The economic attractiveness of solar/gas systems to the gas consumer is analyzed on a regional basis, and a sensitivity analysis is performed for the most economic solar/gas systems. Variables included in the sensitivity analysis are geographical location, solar system capital costs, fuel escalation rates, and government incentive programs.

7031 **The arkla ammonia-water absorption heat pump.** Merrick, R.H. (Arkla Industries Inc.). pp 1262-1267 of Proceedings of the 1981 International Gas Research Conference. Rockville, MD, USA; Government Institutes, Inc. (1982). (CONF-810909—).

From International gas research conference; Los Angeles, CA, USA (28 Sep 1981).

Arkla is developing a residential air souce ammonia-water absorption heat pump designed to operate in the heating mode only and deliver its output as hot water. The current design which is to be used for life and field testing has a 50,000 Btuh input with a COP of 1.25 at 47F' ambient and 1.12 at 17F. The ammonia-water

approach combines excellent thermodynamics with mechanical features well suited to residential application. The non reversing design has been chosen to maximize cold weather COP and minimize cost and complexity. Field testing of 10 to 25 units is programmed for the coming winter.

7032 **An assessment of the feasibility of widespread photovoltaic retrofits.** Jackson, J.L. (PV System Definition Division 4723, Sandia National Laboratories, Albuquerque, NM 87185). pp 25-30 of Advances in energy technology. Sauer, H.J.; Hegler, B.E. Rolla, MO, USA; Univ. of Missouri-Rolla (1981). (CONF-811137—).

From University of Missouri Department of Natural Resources conference on energy; Rolla, MO, USA (6 Nov 1981).

Residential and commercial retrofits may represent a significant national market for photovoltaic (PV) systems. We discuss techniques for estimating this market and present preliminary conclusions about physical market size. Some of the economic implications of retrofits and retrofit designs which might be employed are considered. Finally, we review possible institutional barriers to widespread retrofits.

## 3202 Transportation

7033 **(CONF-850115—2) Long term outlook for transportation energy demand.** Millar, M.; Vyas, A.; Saricks, C. (Argonne National Lab., IL (USA)). 1985. Contract W-31-109-ENG-38. 35p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE84017495.

From 64. annual Transportation Research Board meeting; Washington, DC, USA (21 Jan 1985).

A forecast of US transportation energy demand by mode and fuel type is presented and contrasted with several other long-range transportation energy forecasts recently appearing in the literature. The methodology, principal assumptions and key findings of the forecast are discussed and an attempt is made to identify certain of the underlying factors influencing the basic assumptions and results of the forecasts. The paper concludes with several observations on the appropriate role and focus for forecasts in general and transportation energy forecasts in particular.

7034 **(DOE/CS/54262—T1) 1979 energy efficient vehicle competition. Final report.** McGill, R.A.; Conroy, R.; Sununu, J.H.; Williamson, N.; Rice, C.; Roan, V.P. (SCORE, Inc., Cambridge, MA (USA)). Oct 1979. Contract FG01-78CS54262. 341p. NTIS, PC A15/MF A01; 1; GPO Dep. File Number DE85002855.

The following aspects of the Energy Efficient Vehicles Competition are included: development, objectives, history, timetable, symposia, testing program, vehicle description, scores and awards, educational impact, media coverage, and finances. (MHR)

7035 **(LBL—18425) Quality assurance assessment of new efficient lighting systems for Naval ships. Final report.** Verderber, R. (Lawrence Berkeley Lab., CA (USA)). Aug 1984. Contract AC03-76SF00098. 29p. (EEB-L—84-13). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85004346.

Ballasts and lamps, which have been selected to replace existing lamp/ballast systems based on improved performance, were tested to determine if they meet standard Naval MIL specifications. Fifty ballasts manufactured by Advance Transformer Corporation and Universal Manufacturing Corp., and 100 lamps manufactured by GTE were tested to determine their quality assurance and durability. These components met all of the MIL specifications that lamp/ballast systems in use must meet. In addition, these new systems have an improved system efficacy, 62 lumens per watt, and lower third harmonics, which will reduce the need for generating capacity for lighting on ships.

7036 **(PB—84-217967) Railways and energy. World Bank staff working paper.** Alston, L.L. (International Bank for Reconstruction and Development, Washington, DC (USA)). 1984. 94p. (WP—634). NTIS MF A01.

Library of Congress catalog card No. 84-3506. Abstracts in Spanish and French.

This paper addresses questions which arise in discussions about the effects which increases in oil prices have on railway development. Part I of the paper reviews the relative energy efficiencies of rail and of road transport, and measures for decreasing railway energy consumption. Only energy used for traction is considered. Part II is a review of the factors which determine the economic viability of railway electrification, and includes a methodology which can readily be used for prefeasibility analyses to determine whether a more detailed study is warranted. (Copyright (c) 1984 The International Bank for Reconstruction and Development/ The World Bank.)

7037 **(PB—84-219203) Effects of test vehicle mileage on Corporate Average Fuel Economy calculations. Technical report.** (Environmental Protection Agency, Ann Arbor, MI (USA)). Nov 1983. 29p. NTIS, PC A03/MF A01.

The purpose of this report is to estimate the annual Corporate Average Fuel Economy (CAFE) credit manufacturers obtain by testing motor vehicles at greater than 4,000 miles accumulation.

7038 **Uncertainty in the price of gasoline and the automobile manufacturers' 1990 retooling decision.** Ford, A. (Los Alamos National Laboratory, Los Alamos, NM). *Energy (Oxford);* 9: No. 6, 519-540(Jun 1984).

The authors present an analysis of the retooling decision of a full-line automobile manufacturer facing large uncertainty in the price of gasoline. The paper focuses on the appropriate mix of five car classes to be produced in 1990. By calculating the severity of a possible market mismatch problem with different retooling decision, it is shown that the effect of different strategies that could minimize the adverse effects of world oil price uncertainty. The manufacturer's retooling decision is considered with (1) no competition, (2) competition from another full-line company, and (3) competition from another full-line company and a limited-line foreign manufacturer. Of particular interest is whether the market risks are so great that government intervention is required to assist the manufacturers in planning for an uncertain future. Specifically, the authors question whether the corporate average fuel efficiency standards should be extended past 1985 to encourage automobile manufacturers to retool for increased fuel efficiency in the face of highly uncertain gasoline prices.

## 3203 Industry And Agriculture

*REFER ALSO TO CITATION(S) 3203006304, 6307, 6323, 6324, 6325, 6552, 7056, 7061, 7188*

7039 **(AD-A—142-821) Heat recovery from ketene gas cooldown.** Wolverton, L.E. (Holston Defense Corp., Kingsport, TN (USA)). Jun 1984. 76p. NTIS, PC A05/MF A01. File Number TI85900223.

Part of an Army energy conservation project was to determine the feasibility and economics of using a gas-to-gas heat exchanger to recover a portion of the heat from the hot ketene vapor leaving a cracking furnace by using the hot stream to preheat combustion air used in the furnace burners. Assessing the potential benefits of the heat recovery process included the design, procurement, installation, and evaluation of a heat exchanger and related equipment. The results of the evaluation work and the economic analysis of the process are included in this report.

7040 **(AD-A—144679/8) Statistical analysis of Naval activity electrical consumption. Final report October 1983-March 1984.** de Monsabert, S. (VSE Corp., Camarillo, CA (USA)). Jun 1984. 35p. NTIS, PC A03/MF A01.

The electrical consumptions of Naval shore facilities for 1983 were regressed with current square footage areas for then different facility types. The data used was from the FASCO NFA/ MAGIC and DEIS II data bases. The annual electrical consumption was found to vary from 2.4 kilowatt-hours per square foot for storage facilities to 34 kilowatt-hours per square foot for production facilities.

7041 **(DOE/CS/40091—T13) Directory of industrial energy conservation opportunities (DIECO).** Duke, L.D. (University City Science Center, Philadelphia, PA (USA)). Aug 1984. Contract AC01-78CS40091. 23p. Univ. City Science Center, 3624 Market Street, Philadelphia, PA 19104. File Number TI85000421.

This Directory has been assembled to systematize the collection, computerized storage, and analysis of energy conservation opportunities (ECOs). Energy Conservation Opportunities (ECOs) are organized into major groups, subgroups, and ECO types. Each major group is labeled with a two-digit number, ending in zero; each subgroup is also labeled with a two-digit number, beginning with the same digit as the associated major group. Each ECO type carries a four-digit number, of which the first two are the same as the code of the associated subgroup, and the fourth is a zero. The DIECO system is intended to group ECOs logically for easy reference and access, minimize redundant ECO listings, organize ECOs hierarchically to allow data analysis at several levels of detail, and cross-reference similar ECOs which may refer to different areas of industrial energy usage.

7042 **(GA-A—17779) Acoustic resonance in heat exchanger tube banks. Second annual report.** Blevins, R.D. (GA Technologies, Inc., San Diego, CA (USA)). Nov 1984. Contract AT03-82ER12023. 59p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85004395.

The study of the fluid mechanics of acoustic resonance in heat exchanger tube bundles continues. The previous work included review of data and theory, development of models for the acoustics of tube bundles, and construction of a wind tunnel and tube array model. In the present phase of the program, both the wind tunnel model and the analytical model were exercised. Using the wind tunnel, the ability of coherent sound to shift the natural frequency of vortex shedding was demonstrated. Sound at the vortex shedding frequency can also increase the magnitude of the shed vortex and increases the spanwise coherence. Acoustic resonance due to vortex shedding from tube arrays was observed. The acoustic mode of the resonance has been measured, and it is found to agree well with analytical predictions. Work on deveopment of a nonlinear dynamic model for vortex shedding has been initiated. This model features coupled nonlinear oscillators that will simulate the sound-induced entrainment phenomena.

7043 **(INIS-mf—9092) Waste heat utilization in agriculture. Proceedings of the meetings of the ESNA working group on "Waste heat utilization", Brno, Czechoslovakia, May 20-22, 1980; Aberdeen, United Kingdom, Sept. 28 - Oct. 2, 1981; Brno, Czechoslovakia, September 6-11, 1982.** Horacek, P. (ed.). (European Society of Nuclear Methods in Agriculture (ESNA), Wageningen (Netherlands); Ceskoslovenska Komise pro Atomovou Energii, Prague). 1983. 44p. (CONF-8005259—; CONF-8209259—; CONF-8109136—). NTIS (US Sales Only), PC A03/MF A01. File Number DE85780146.

From ESNA working group meeting on waste heat utilization; Brno, Czechoslovakia (20 May 1980).

The Proceedings contain 17 papers presented at meetings of the Working Group for Waste Heat Utilization of the Committee of the European Society of Nuclear Methods in Agriculture of which 7 fall under the INIS scope. The working group met in May 1980 in Brno, Czechoslovakia, in October 1981 in Aberdeen, Scotland and in September 1982 in Brno.

7044 (INIS-mf—9092, pp 9-15) **Introductory remarks.** Horacek, P. (Ceskoslovenska Komise pro Atomovou Energii, Prague). 1983. NTIS (US Sales Only), PC A03/MF A01. File Number TI85780146. (CONF-8005259—; CONF-8209259—; CONF-8109136—).

From ESNA working group meeting on waste heat utilization; Brno, Czechoslovakia (20 May 1980).

The brief history is outlined of the establishment of the ESNA Working Group on Waste Heat Utilization. Among the main factors which led to this step was the need to enlarge food resources, to reduce current energy consumption and to limit increasing environmental pollution. Briefly discussed are problem areas linked with these factors; also presented are the results of certain experiments carried out in this field. The working group provides a forum for discussion, allows the exchange of information on research programmes and secures the quick transmission of obtained results.

7045 (INIS-mf—9092, pp 16-21) **Review of 6 -years of research work by the SERE/DPR/IPSN--breeding.** Delmas, J.; Guillermin, P.; Foulquier, L.; Grauby, A. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France). Service d'Etudes et Recherches sur l'Environnement). 1983. NTIS (US Sales Only), PC A03/MF A01. File Number TI85780146. (CONF-8005259—; CONF-8209259—; CONF-8109136—).

From ESNA working group meeting on waste heat utilization; Brno, Czechoslovakia (20 May 1980).

Waste heat from the experimental reactors of the CEA nuclear centre in Cadarache has been used for agricultural purposes since 1974. The experimental plot is about 1 km distant from the centre. The temperature of the water is about 10 degC higher than that of the water in the river Durance and it is supplied through the usual aluminium irrigation pipe. Soil is heated either with metal or plastic buried pipes or perforated surface pipes. The research programme has yielded excellent results in all experimentaly grown plants. Thus, for instance, strawberry yields were three times higher than the yields reached in the best fields in the neighbouring area. Tomatoes ripened earlier and had bigger yields. The same was true of melons, early potatoes, maize, asparagus, etc. The effects of irrigation with warm water were also observed on the growth of poplars where the wood pulp growth rate was 10% higher. On the basis of successful results of fish farming using waste heat in Cadarache a prototype unit for eel breeding was set up at the CEA nuclear centre in Pierrelatte. It is envisaged that an industrial unit with an annual capacity of several tons of fish will be set up on the banks of the fish breeding pond which covers an area of 3 ha.

7046 (INIS-mf—9092, pp 36-39) **Waste heat utilization in greenhouses - Institute of nuclear research activities.** Pietrzykowski, M. (Institute of Nuclear Research, Warsaw (Poland)). 1983. NTIS (US Sales Only), PC A03/MF A01. File Number TI85780146. (CONF-8005259—; CONF-8209259—; CONF-8109136—).

From ESNA working group meeting on waste heat utilization; Brno, Czechoslovakia (20 May 1980).

The system is described of the use of waste water from the secondary coolant circuit of the Polish experimental reactor EWA for heating an experimental greenhouse. Water from the reactor with a temperature of 26 degC transmits heat in the water-air exchanger. An analysis made of the heat transfer between the greenhouse environment and the outdoor atmosphere showed that it is possible to secure permanent air parameters inside the greenhouse within a broad range of ambient meteorological parameters such as air temperature and moisture, wind velocity and intensity of solar radiation. On the basis of computations the necessary characteristics were determined of the control system for ambient temperatures ranging from -20 degC to +35 degC. They also took into consideration the amount of thermal energy generated in the greenhouse by solar radiation. The first results obtained on the prototype equipment confirmed the correctness of the concept of the designed system, this namely for applications in large installations using power plant waste heat.

7047 (INIS-mf—9092, pp 76-79) **Waste heat utilization in greenhouses.** Curylo, E.; Jodkowski, C. (Power Engineering Study and Design Office ENERGOPROJEKT, Warsaw (Poland)). 1983. NTIS (US Sales Only), PC A03/MF A01. File Number TI85780146. (CONF-8005259—; CONF-8209259—; CONF-8109136—).

From ESNA working group meeting on waste heat utilization; Brno, Czechoslovakia (20 May 1980).

In Poland two techniques are used in the utilization of waste heat from power plants for heating greenhouses. The former technique uses heated water from the secondary coolant circuit of the reactor. The heat exchanger exchanges heat between water and air. The equipment comprises a heat exchanger and a moisturizing chamber which is a modified air-conditioner and has been installed and tried. The latter technique which has also been experimentally

tried consists in the installation of horizontal fans inside the cooling tower. These force the heated air into the greenhouses where it flows between double walls and a double roof. The first technique has proved more efficient because the temperature of the water fed to the greenhouses is higher and more stable. Efforts are also being made to optimize the greenhouse design. Vegetables yields which have thus been achieved have exceeded expectations.

7048 (INIS-mf—9092, pp 80-82) **Present status of waste heat utilization in CSSR.** Horacek, P. (Ceskoslovenska Komise pro Atomovou Energii, Prague). 1983. NTIS (US Sales Only), PC A03/MF A01. File Number TI85780146. (CONF-8005259—; CONF-8209259—; CONF-8109136—).

From ESNA working group meeting on waste heat utilization; Brno, Czechoslovakia (20 May 1980).

In Czechoslovakia a project of a nuclear agricultural complex has been designed for waste heat utilization. The experimental base comprises greenhouses covering 0.2 $km^2$, plastic crop shelters of the same size, plots with heated soil on an area of 0.07 $km^2$, fields and groves on an area of 0.02 $km^2$ irrigated with warm water and frost protected and a warm water fish breeding unit. Since 1971 an experimental trout and carp hatchery has been in operation which uses waste heat from the Tisova power plant. Attention is not only focused on using waste heat in traditional agricultural production but also in algae growing. It has been calculated that waste heat from one single nuclear power plant amounts to 25,000 TU per year which is equivalent to more than 600,000 tons of crude oil. The economic contribution of waste heat utilization is evident, on the other hand the capital costs of all types of waste heat utilization are high.

7049 (INIS-mf—9092, pp 128-129) **Conditions of utilization of waste and low-potential heat from nuclear power stations for agricultural production in Czechoslovakia.** Soucek, V. (Federalni Ministerstvo Paliv a Energetiky, Prague (Czechoslovakia)). 1983. NTIS (US Sales Only), PC A03/MF A01. File Number TI85780146. (CONF-8005259—; CONF-8209259—; CONF-8109136—).

From ESNA working group meeting on waste heat utilization; Brno, Czechoslovakia (20 May 1980).

Briefly discussed are the economic aspects of the utilization of waste heat and low-grade heat from power plants for agricultural uses in Czechoslovak conditions. Considered are the heating of greenhouses and similar units as well as other processes in agricultural production. Agricultural compiexes are currently being designed which are to be built in the years 1985 to 1990 and which are to utilize waste heat from the nuclear power plants at Jaslovske Bohunice and Dukovany and from coal burning power plants at Detmarovice and Tisova.

7050 (ORNL/Sub—83-43337/1) **Multi-stage absorption heat pumps for industrial applications. Final report.** Grossman, G. (Technion-Israel Inst. of Tech., Haifa). Nov 1984. Contract AC05-84OR21400. 40p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85003823.

This study surveys possible multi-stage schemes of absorption heat pumps for industrial applications. A systematic approach is taken to identify systems with improved coefficient of performance, greater temperature boost and combined cooling/heating effects. Operating diagrams of these systems are described and a comparison between them given, based on performance criteria and potential cost.

7051 (PB—84-237791) **Procedure to estimate the installation cost of advanced energy recovery systems.** Desai, T.M.; Salama, S.Y.; Forshay, P.H. (Energy and Environmental Analysis, Inc., Arlington, VA (USA)). Jun 1984. 114p. NTIS, PC A06/MF A01.

This report was written to develop a consistent procedure for estimating the installation cost of industrial Energy Recovery Systems (ERS) as a basis for comparing different ERS configurations, e.g., different ERS or centralized versus modular ERS. Under its Industrial Utilization program, GRI is funding the development of technologies to improve the efficiency of gas utilization in a wide range of industrial applications. A standardized approach is required to estimate in a consistent manner the installation cost of ERS for planning and analysis purposes. In the absence of such an approach, cost estimates could differ in the amount and type of auxiliary equipment included in the installation and the accuracy of cost estimates, thus potentially resulting in misleading conclusions. The procedure developed here is aimed at meeting this need. Specifically, it can be used for the following types of analysis: (1) comparison of various ERS with differing performances, (2) comparison of different ERS configurations such as centralized ERS versus modular ERS, (3) determination of optimum preheat temperature for a furnace, and (4) estimation of installed cost of new energy recovery devices for cost/benefit analysis.

7052 **Heat exchangers for secondary heat recovery from glass plants.** Webb, R.L.; Durbin, R.E.; Kulkarni, A.K.; Marchiori, D.; Wang, Y.J. (Dept. of Mech. Eng., Pennsylvania State Univ., PA). *Journal of Heat Recovery Systems;* **4**: No. 2, 77-85(1984).

This paper addresses heat recovery from the exhaust gases leaving the brick checkers regenerator of a soda lime glass furnace. The most desirable uses for the recovered heat are electricity generation and batch preheat. An industry survey indicated that heat exchanger fouling is a primary factor that inhibits use of such heat recovery. For electricity generation, one would use either a Rankine or a Brayton cycle. The former would use a finned-tube heat exchanger, and the latter would use a plateand-fin exchanger. This paper discusses the fouling, corrosion and cleanability of such heat exchangers in the glass furnace exhaust. The composition of the gases entering the exchanger is described and the expected fouling mechanisms are discussed. It is concluded that these exchangers should be cleanable and not subject to excessive corrosion, provided they operate above the acid dewpoint. The use of MgO would further enhance the cleanability of the fouling deposit. The fluidized-bed heat exchanger is an interesting concept for batch preheat. If the concept can be successfully employed, it would be a "self cleaning" heat exchanger.

## 3206 Municipalities And Community Systems

*REFER ALSO TO CITATION(S) 3206006307, 6620, 6726, 6727, 7303, 7529*

7053 (AD-A—143378/8) **Effects of minor constituents in calcium silicate insulation on the corrosion of underground heat distribution systems. Final report.** Segan, E.G.; Blackman, E.W.; March, C. (Army Construction Engineering Research Lab., Champaign, IL (USA)). May 1984. 20p. (CERL-TR-M—346). NTIS, PC A02/MF A01.

This report presents the results of an investigation of the harmful corrosive effects of minor constituents in calcium silicate insulation on prefabricated steel conduit underground heat distribution systems. The research showed that the leachable chloride concentrations of commercially available calcium silicate insulation can contribute greatly to the corrosion of underground heat distribution systems and that the corrosion is aggravated if leaks in the system continue for long periods of time. Corrective measures are recommended to minimize this type of corrosion.

7054 (DOE/CS/20097—T1) **Delivery of Puente Hills Landfill gas to Rio Hondo College. Development of the utilization of combustible gas produced in existing sanitary landfills.** (Los Angeles County Sanitation Districts, Whittier, CA (USA)). [1984]. Contract FG01-79CS20097. 128p. NTIS, PC A07/MF A01; GPO Dep. File Number DE85001490.

The Rio Hondo Gas Delivery project was planned with the objective of supplying Puente Hills Landfill gas to operate four existing boilers at the Rio Hondo College, Whittier, California. These boilers were operated on natural gas, the supply of which was subject to interruption by the utility during periods of gas shortage. Oil was used as standby fuel. The project consists of building a gas compressor facility, a gas delivery pipeline and modification of the boilers to enable them to burn landfill gas. The pipeline and the compressor station have been installed. Two of the four boilers have been modified and the other two will be converted soon. The project has been in operation since June, 1984, and no operating problems beyond normal start up difficulties have been experienced

so far. To date the project has cost $519,000 out of which $100,000 has been funded by the US Department of Energy (DOE).

7055 **(EUR—8393) Waste paper prospects in the European Community.** (Commission of the European Communities, Luxembourg). 1983. 180p. (EUR—8393-EN). NTIS, PC E08/MF E08.

This report investigates the potential for increasing the recovery rate (supply of) and/or the utilization rate (demand for) waste paper in the European Community. Concern about the problem derives both from the proportion of the Community's import bill attributed to the imports of virgin pulp and paper, and to the contribution of paper to the Community's municipal and commercial waste streams.

7056 **(PB—84-225861) Electrolytic stripping of tin in an acid fluoborate electrolyte. Report of investigations/1984.** Groetsch, J.G. Jr.; Gabler, R.C. Jr.; Wilson, D.A. (Bureau of Mines, Avondale, MD (USA). Avondale Research Center). 1984. 16p. (BM-RI—8887). NTIS, PC A02/MF A01.

Library of Congress catalog card No. 84-600092.

Municipal solid waste (MSW) contains about 8 pct ferrous metallics which are typically recovered by magnetic separators at municipal resource recovery facilities. At present, only about 182,500 ton/yr of MSW magnetics are being processed for remelting out of the about 11 MMton/yr discarded. The Sn in MSW magnetics makes this material difficult to recycle to the steel industry. An electrolytic method using stannous fluoborate-fluoboric acid for removing Sn was evaluated. Good results were obtained with MSW magnetics, after pretreatment by reshredding, magnetic separation, and air classification. The final Sn content of the MSW magnetics scrap was reduced from 0.18 to 0.017 wt pct. Heat and solvent treatments of MSW magnetics to remove coatings did not significantly improve Sn removal beyond that obtained with material that had only been mechanically pretreated.

### 3209 Education And Public Relations

*REFER ALSO TO CITATION(S) 3209006995*

## 33 ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

*REFER ALSO TO CITATION(S) 3300007034*

### 3301 Internal Combustion Engines

*REFER ALSO TO CITATION(S) 3301007069*

7057 **(CONF-831297—1) Survey of present petrol injection systems.** Knapp, H. (Bosch (R.) G.m.b.H., Stuttgart (Germany, F.R.)). 1983. 22p. (In German). NTIS (US Sales Only), PC A02/MF A01. File Number DE85770092.

From Seminar on comblustion engines; Karlsruhe, F.R. Germany (13 Dec 1983).

The technical advantages of petrol injection compared to conventional carburettor systems include: precise measurement of the optimum quantity of fuel in all working conditions of the engine, supply of precisely dosed quantity of fuel to the engine inlet valves and supply of all cylinders with the same amount of fuel. These technical characteristics make it possible to improve all the engine parameters, such as output and torque curve, exhaust gas, consumption and driving characteristics. A forecast gives 45% full injection, 50% central injection, 5% carburettor. A survey of injection systems produced at present and their further development is given. These include K, L and LH Jetronic. Information is provided on peculiarities of operation and output capacity. There is also information on central injection, fuel consumption and reduction of noxious substances, particularly with reference to the expected laws on this in Germany and the rest of Europe.

7058 **(CONF-850115—1) Introducing engine innovations: an examination of future markets for Brayton and Stirling automotive engines.** Santini, D.J. (Argonne National Lab., IL (USA)). Aug 1984. Contract W-31-109-ENG-38. 40p. NTIS, PC A03/MF A01; GPO Dep. File Number DE84016319.

From 64. annual Transportation Research Board meeting; Washington, DC, USA (21 Jan 1985).

This paper takes a general and particular view of the process of engine innovation. The history of engine innovation in automobiles and railroads is briefly reviewed and related to the potential path of automotive engine innovation that may occur toward the turn of the century. It is shown that automotive engine innovation in the past has been costly, especially to lower income consumers, and that potential future adoption of Stirling and Brayton (gas turbine) engines is unlikely to be any different. The danger of negative economic side effects during the innovation process for the automobile industry and nation are noted. It is suggested that careful corporate and national preparation for automotive innovation is necessary. To that end, advanced (year 2000) engine and vehicle characteristics from the Technology Assessment of Productive Conservation in Urban Transport are used to estimate that the Stirling and Brayton engines are likely to have very specific and different markets. Driving cycle behavior of the engines in an urban and suburban setting is examined to show that the Stirling's most likely market will be as a specialized urban vehicle, while the Brayton's best market will be as a specialized suburban and inter-city vehicle. It is argued that neither engine has the properties necessary to become a universal replacement for all purpose vehicles using advanced Otto-cycle and diesel engines, but that proper use of these vehicles could ultimately help efficiently mitigate national problems of urban air pollution (the Stirling) and/or excessive fuel consumption. Finally, it is pointed out that recent EPA methods of evaluating vehicle fuel efficiency could incorrectly lead to a negative economic evaluation of advanced Stirling and Brayton engines, tending to unjustifiably retard their introduction into the market.

7059 **(CONF-850115—4) Structural ceramics in transportation: fuel implications and economic impacts.** Teotia, A.P.S.; Johnson, L.R. (Argonne National Lab., IL (USA)). 1985. Contract W-31-109-ENG-38. 23p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003024.

From 64. annual Transportation Research Board meeting; Washington, DC, USA (21 Jan 1985).

The potential application of structural ceramics in motor vehicle engines is described. The high temperature strength characteristic plus the properties of resistance to wear and corrosion make these high-tech ceramics excellent candidates for the harsh environment of the advanced engine systems being considered for automobiles and trucks. The critical role of ceramics in the adiabatic diesel, gas turbine and Stirling engine is discussed, along with an indication of the fuel efficiency potential and multi-fuel capability of each engine. A market penetration analysis of the advanced engines is reviewed and forms the basis of developing two alternative commercialization scenarios for ceramic component engines - one with the United States dominating the market and the other with Japan dominating. Changes in major national economic indicators are noted after simulating the economy with a macroeconomic model. Strategic materials impacts are also noted.

7060 **(DOE/ET/12236—1) Improved spark ignition engine efficiency through turbosupercharged lean operation. Final report.** Johnson, R.T. (Missouri Univ., Rolla (USA). Dept. of Mechanical Engineering). Nov 1981. Contract FG19-78ET12236. 98p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85003671.

A comprehensive test program to evaluate Lean Supercharged Operation (LSO) of the spark ignition engine for improved efficiency was conducted. The evaluation involved two major experimental programs: an initial study of the power, emissions and efficiency of a single cylinder engine, followed by a series of tests using a turbocharged multicylinder engine to verify results. The relationships between engine power, efficiency, and emissions and the engine operating variables such as absolute intake manifold pressure, Exhaust Gas Recirculation rates, and spark timing were studied. Results from both phases of the experimental program indicat-

ed that LSO can provide significant improvements in engine efficiency for NO/sub x/ emissions comparable to, or lower than, the naturally aspirated engine. For equal power output from the single cylinder engine, efficiency increases of 2.25 points (14%) were accompanied by reductions in Brake Specific NO/sub x/ (BSNO/sub x/) emissions of approximately 76%. For a case at equal BSNO/sub x/ emissions, an efficiency improvement of 6.4 points or over 40% was observed. Although not as dramatic, similar improvements were obtained from the turbocharged multicylinder engine. In both cases, the improvements were significant only at higher values of absolute intake manifold pressure. A smaller displacement engine operating at higher mean effective pressures will be needed to utilize the benefits of Lean Supercharged Operation.

7061 **(DOE/NASA/50194—41) Overview of waste heat utilization systems.** Bailey, M.M. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1984. Contract AI01-80CS50194. 10p. (CONF-8410103—1; NASA-TM—86901). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003887.

From Automotive technology development contractors' coordination meeting; Dearborn, MI, USA (29 Oct 1984).

The heavy truck diesel engine rejects a significant fraction of its fuel energy in the form of waste heat. Historically, the Department of Energy has supported technology efforts for utilization of the diesel exhaust heat. Specifically, the Turbocompound and the Organic Rankine Cycle System (ORCS) have demonstrated that meaningful improvements in highway fuel economy can be realized through waste heat utilization. For heat recovery from the high temperature exhaust of future adiabatic diesel engines, the DOE/NASA are investigating a variety of alternatives based on the Rankine, Brayton, and Stirling power cycles. Initial screening results indicate that systems of this type offer a fuel savings advantage over the turbocompound system. Capital and maintenance cost projections, however, indicate that the alternative power cycles are not competitive on an economic payback basis. Plans call for continued analysis in an attempt to identify a cost effective configuration with adequate fuel savings potential.

7062 **(NP—5770079) New directions in automotive engineering.** (Bosch (R.) G.m.b.H., Stuttgart (Germany, F.R.)). 1984. 48p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85770079.

This gives a short survey of a number of newly developed technical systems and equipment for vehicles. The basis principle of the system, its range of applications and its capacity are shown with a wealth of illustrations. The following are mentioned: Intermittently working petrol injection systems with and without measurement of the quantity or weight of air, continuously working petrol injection systems with mechanical or electronic controls, reasonably priced central injection system, lambda sensor (reducing noxious substances in the exhaust gas), tickover-filling control, electronic ignition, control of 'knocking', data processing system for the engine, electrical injection control for Diesel engines, electronic controls for automatic gearboxes, starter with sun and planets gears for Diesel engines, anti-locking systems (ABS) for private cars and commercial vehicles, tripping equipment for passive restraint systems, control of width of headlight beams, electronic heating control, computers for driving data, integrated driver's information, ploughing depth control system for farm tractors, regulation and control equipment as hybrid microcircuit, the Compactest system.

7063 **(NP—5770088) Mixture formation and combustion development in the engine of the 190 E.** Schaefer, M. (Karlsruhe Univ. (T.H.) (Germany, F.R.). Inst. fuer Kolbenmaschinen). 1983. 29p. (In German). NTIS (US Sales Only), PC A03/MF A01. File Number DE85770088.

The 4-cylinder power unit of the 190 E is a document of the most advanced state of engine development, performance and speed characteristics and low specific fuel consumption. The injection system combines in the best possible way the advantages of a mechanical/hydraulic system and the enormous possibilities of modern electronic control engineering. This allows high precision and low quality scattering within a series and also to adapt the engine to the most varied operational conditions, thus making a noticeable contribution to the reduction of environmental pollution.

7064 **(NP—5770093) Modern Diesel injection technique.** Straubel, M. (Bosch (R.) G.m.b.H., Stuttgart (Germany, F.R.)). 1984. 42p. (In German). NTIS (US Sales Only), PC A03/MF A01. File Number DE85770093.

In the Diesel engine, fuel is injected at high pressure, at the correct time and precisely dosed into the combustion space. Expressed numerically, this means: the injected quantity for a large Diesel engined car of 50 $mm^3$ (a drop from a medicine bottle) must be precised dosed in 1/1000 s to about 3/100 of a drop; the whole process is repeated up to 250 times per second in a distributor injection pump. It is explained how this high degree of precision is achieved in a generously illustrated booklet with section on pressure generation (distributor pump, rotary supply pump, delivered quantity, control, roller tappets, camshaft, bearings), controlling the high injection pressure (pressure wave moves at the speed of sound, nonreturn throttle, constant pressure valve) and regulation (mechanical Diesel governor, electrical pump regulation, needle movement sensor in nozzle holder, electro-hydraulic control mechanism).

7065 **US national programs in ceramics for energy conversion.** Katz, R.N.; Schulz, R.B. (US Army, Army Materials and Mechanics Research Center, Watertown, MA). pp 727-735 of Progress in nitrogen ceramics. Boston, MA, USA; Hague, Martinus Nijhoff Publishers (1983). (CONF-8107129—).

From 2. advanced study institute conference on progress in nitrogen ceramics; Brighton, UK (27 Jul 1981).

The present investigation is primarily concerned with the utilization of ceramics for advanced heat engine developments. The driving force behind efforts to use ceramics in energy conversion devices is related to the need to lessen the dependence on imported oil and imported strategic metals. The full implementation of ceramic configured gas turbines and industrial heat exchangers could save $17.5 billion in oil imports. The U.S. ceramic configured gas turbine programs during the time from 1971 to 1980 are discussed along with the U.S. ceramic configured heat engine programs for the time starting in the spring of 1981. Attention is given to a number of recent advances related to gas turbines, Diesel engine technology, and turbochargers. 14 references.

## 3302 External Combustion Engines

*REFER ALSO TO CITATION(S) 3302007038, 7059*

7066 **(DOE/ET/32002—T1) Stirling Isotope Power System Program. Final report, January 1978-December 1980.** (General Electric Co., Philadelphia, PA (USA). Space Systems Div.). Dec 1980. Contract AC01-76ET32002. 293p. NTIS, PC A13/MF A01; 1; GPO Dep. File Number DE85002494.

The Stirling Isotope Power System (SIPS) design is discussed, including the control system and engine starter. The development, of fabrication, and testing of the SIPS converter are presented. The work performed on the Isotope Heat Source Assembly is described. The ancillary equipment, system integration and qualification, and safety are discussed. The safety discussion consists primarily of prediction of dose rates around the IHS and the influence on handling equipment design. Reliability and quality assurance are included. (MHR)

7067 **Advanced high temperature materials for the energy efficient automotive Stirling engine.** Titran, R.H.; Stephens, J.R. (NASA Lewis Research Center, Cleveland, OH). *Journal of Materials for Energy Systems;* 6: No. 2, 114-121(Sep 1984).

The Stirling engine is under investigation jointly by the Department of Energy and NASA Lewis as an alternative to the internal combustion engine for automotive applications. The Stirling engine is an external combustion engine that offers the advantage of high fuel economy, low emissions, low noise, and low vibrations compared to current internal combustion automotive engines. The most critical component from a materials viewpoint is the heater head consisting of the cylinders, heating tubes, and regenerator housing. Materials requirements for the heater head include com-

patibility with hydrogen, resistance to hydrogen permeation, high temperature oxidation/corrosion resistance, and high temperature creep-rupture and fatigue properties. A continuing supporting materials research and technology program has identified the wrought alloys CG-27 and 12RN72, and the cast alloys XF-818 and NASAUT 4G-A1 as candidate replacements for the cobalt containing alloys used in current prototype engines. Based on the materials research program in support of the automotive Stirling engine it is concluded that manufacture of the engine is feasible from low cost iron-base alloys rather than the cobalt alloys used in prototype engines. This paper presents results of research that led to this conclusion.

### 3304 Hybrid Systems

7068 **(DOE/CS/54209—15) Evaluation of heat engines for hybrid vehicle application.** Schneider, H.W. (Jet Propulsion Lab., Pasadena, CA (USA)). 31 Aug 1984. Contract AI01-78CS54209. 71p. (JPL-PUB—84-14). NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85004585.

The status of ongoing heat-engine developments, including spark-ignition, compression-ignition, internal-combustion, and external-combustion engines is presented in this report. The potential of engine concepts under consideration for hybrid vehicle use is evaluated, using self-imposed criteria for selection. The deficiencies of the engines currently being evaluated in hybrid vehicles are discussed. The study focuses on recent research with two-stroke, rotary, and free-piston engines and concludes that these engine concepts have the most promising potential for future application in hybrid vehicles. Recommendations are made for analysis and experimentation to evaluate stop-start and transient emission behavior of recommended engine concepts.

### 3308 Alternative Fuels

7069 **Transamerica Delaval seeks to use coal liquids as diesel fuel.** *Power;* **124**: No. 7, 125(Jul 1980).

Transamerica Delaval Inc., a manufacturer of industrial engines, is conducting the first U.S. test of synthetic fuels in diesel engines. The 16 mo, $2 million study, partially (24%) funded by the U.S. Department of Energy, seeks to discover a combination of engine modifications and fuel blending that will make coal liquids and shale oil usable by diesels. Coal liquids, such as SRC-II (solvent-refined coal), the first fuel to be tested, cannot serve as diesel fuel because, in an unmodified system, their ignition requires temperatures and pressures too high for diesel engines. The research program will test a pilot injection system which would spurt a small amount of diesel fuel into the combustion chamber and follow with the SRC-II main charge. The diesel fuel would act as a blowtorch to fire the coal liquid.

## 36 MATERIALS

7070 **(EGG-M—14684) Modeling thermal plasma material processing experiments.** Varacalle, D.J. Jr.; Richardson, L.S.; McIlwain, M.E. (EG and G Idaho, Inc., Idaho Falls (USA)). 1984. Contract AC07-76ID01570. 13p. (CONF-841157—19). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85001551.

From Symposium on the scientific basis for nuclear waste management; Boston, MA, USA (26 Nov 1984).

Spatial distributions of plasma variables (concentration, temperature, and velocity) were calculated for alumina and carbon species injected in an argon thermal plasma. The plasma behavior was modeled from arc initiation through free plume expansion by combining a plasma code with a plume code. The model assumed a direct current, constrictor type, arc heater. This research is examining the feasibility of using thermal plasmas for ore reduction. The process investigated in this paper is the carbothermic reduction of alumina.

7071 **(INIS-mf—9098) MINTEK 50. Abstracts of papers to be presented.** (Council for Mineral Technology, Randburg (South Africa)). 1984. 161p. (CONF-8403156—Absts.). NTIS (US Sales Only), PC A08/MF A01. File Number DE85780156.

From MINTEK 50: international conference on recent advances in mineral science and technology; Sandton, South Africa (26 Mar 1984).

Individual items in scope for the data base were processed separately.

7072 **(ORNL/TM—9357) Metals and Ceramics Division Materials Science Program. Annual progress report for period ending June 30, 1984.** McHargue, C.J. (comp.). (Oak Ridge National Lab., TN (USA)). Nov 1984. Contract AC05-84OR21400. 178p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE85003795.

This report summarizes the activities of the Materials Sciences Program in the Metals and Ceramics Division for the period January 1, 1983, to June 30, 1984. These activities constitute about one-fourth of the research and development conducted by the division. The emphasis of the program can be described as the scientific design of materials. The efforts are directed toward three classes of materials: high-temperature metallic alloys based on intermetallic compounds, structural ceramics, and radiation-resistant alloys.

### 3601 Metals And Alloys

*REFER ALSO TO CITATION(S) 3601006271, 6273, 6275, 6282, 6320, 6466, 6544, 6752, 6759, 6764, 6789, 6865, 7056, 7067, 7159, 7183, 7291, 7294, 7351, 7352, 7898*

7073 **(BNL—35315) Theoretical determination of surface magnetism (invited).** Weinert, M.; Freeman, A.J.; Ohnishi, S.; Davenport, J.W. (Brookhaven National Lab., Upton, NY (USA); Northwestern Univ., Evanston, IL (USA). Dept. of Physics and Astronomy). 1984. Contract AC02-76CH00016. 24p. (CONF-841184—14). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003224.

From 30. annual conference on magnetism and magnetic materials; San Diego, CA, USA (27 Nov 1984).

The theoretical determination of the magnetic structure of surfaces within the (local) spin density formalism is briefly described. The feasibility of using such methods for determining delicate magnetic quantities is illustrated by calculation of the Knight shift of the paramagnetic Pt(001) surface, the magnetization of the clean and Ag-covered Fe(001) surface, and the effect of a p(1x1) H overlayer on the magnetization of a Ni(001) surface. These results demonstrate that it is possible not only to make quantitative predictions for real systems, but more importantly, one gains insight into the underlying physics at surfaces.

7074 **(BNL—35373) Properties of Ti alloyed multifilamentary $Nb_3Sn$ wires by internal tin process.** Suenaga, M.; Klamut, C.J.; Higuchi, N.; Kuroda, T. (Brookhaven National Lab., Upton, NY (USA)). 1984. Contract AC02-76CH00016. 4p. (CONF-840937—21). NTIS, PC A03/MF A01; GPO Dep. File Number DE85003212.

From Applied superconductivity conference; San Diego, CA, USA (9 Sep 1984).

Influence of Ti addition to the Sn core on the critical current density J/sub c/ of multifilamentary $Nb_3Sn$ wires fabricated by the internal tin process was studied. The addition (~ 1.5 wt % Ti) improved the values of J/sub c/ at very high magnetic fields over those for the pure $Nb_3Sn$, e.g., J/sub c/ ~ 140 A/mm$^2$ at 18 T. This is 3 to 4 times greater than a similarly processed pure $Nb_3Sn$ wire and is within ~ 10% of the highest critical current density measured for the Ti alloyed bronze processed $Nb_3Sn$ wires.

**7075 (BNL—35403) Spatial and dynamic spin correlation of CuMn (5 at. %) spin glass: inelastic neutron scattering study.** Uemura, Y.J.; Shapiro, S.M.; Wenger, L.E. (Brookhaven National Lab., Upton, NY (USA); Wayne State Univ., Detroit, MI (USA)). Oct 1984. Contract AC02-76CH00016. 13p. (CONF-841184—17). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003607.

From 30. annual conference on magnetism and magnetic materials; San Diego, CA, USA (27 Nov 1984).

Neutron scattering experiments have been performed on a spin glass CuMn (5 at. %, T/sub g/ = 27.6°K). Polarized neutron measurements with coarse energy resolution show no change of instantaneous spatial spin correlation below T = 60 K. Unpolarized neutron studies with fine energy resolution ($\Delta E = 260$ $\mu$eV) demonstrate that the slowing down of Mn spin fluctuations occur in the same way for all the wave vectors between 0.2 and 4.0 $A^{-1}$. These results indicate that the spatial and dynamic spin correlations are completely decoupled in the spin freezing process. We also study the short-range spatial correlation of the frozen spins at T=5 K using a simple model, and demonstrate the importance of the ferromagnetic coupling between the third nearest neighbor Mn moments.

**7076 (BNL—35424) Magnetic x-ray scattering studies of the rare earth metal holmium.** Gibbs, D.; Moncton, D.E.; D'Amico, K.L. (Brookhaven National Lab., Upton, NY (USA)). 1984. Contract AC02-76CH00016. 18p. (CONF-841184—18). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003608.

From 30. annual conference on magnetism and magnetic materials; San Diego, CA, USA (27 Nov 1984).

We present the results of recent magnetic x-ray scattering experiments on the rare earth metal Ho performed using both a rotating anode source and synchrotron radiation. Specifically, we have measured the Ho(00l)$^{+}$ magnetic satellites in the simple spiral antiferromagnetic phase between 132K and 20K and in the conical phase below 20K. Although the cross section for magnetic x-ray scattering is reduced from the usual Thomson cross-section by a factor of $\simeq 10^{5}$, the incommensurate magnetic satellites are well separated from the main Bragg peaks. Thus, detection of the satellites is possible with a rotating anode source and extensive high resolution studies of them are straightforward with synchrotron radiation. The assembled data are in good agreement with the results of magnetic neutron scattering published previously for different Ho samples.

**7077 (BNL—51816) Verification of multiple steady-states in localized electrochemical corrosion.** Tilly, J.; Mo, T.; Gaudet, G. (Massachusetts Inst. of Tech., Brookhaven, NY (USA). School of Chemical Engineering Practice-Brookhaven Station). Sep 1983. Contract AC02-76CH00016. 71p. (MIT/BNL—83-1). NTIS, PC A04/MF A01; GPO Dep. File Number DE85004566.

By using data reduction techniques suggested by transport models of localized corrosion, the current-time decay curves obtained at different pit depths can be transformed into a single isopotential line which can then be IR-corrected to any desired pit depth. The total error is less than +-7%. Diffusional, solution resistivity, and electromigration effects were adequately accounted for. Two different steady-states, corresponding to a balance of diffusion and electrokinetic rates were experimentally verified for 304L stainless steel and annealed Inconel 600. These two steady-states were found to be stable with respect to current perturbations whereas only the upper steady-state was found to be stable with respect to potential perturbations. The wire surface did not dissolve uniformly at both the upper and the intermediate steady state. A roughened surface at the intermediate steady state resulted from two distinct dissolution regions: one very active and the other one passive. Theoretical prediction of the diffusion length or pit depth for steady state dissolution was about 25 to 30% longer than the observed pit depth. Moreover, the values of the current density observed at steady state were higher than the predicted values. These phenomena can be qualitatively explained either by a greater acidity in the pit at steady state, or by an increase in the surface area of the wire caused by non-uniform dissolution.

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**7078 (CONF-841247—1-Abst.) Influence of work-hardening on the Portevin-LeChatelier effect.** Schwarz, R.B. (Argonne National Lab., IL (USA)). Oct 1984. Contract W-31-109-ENG-38. 3p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85002505.

From 4. simposio chileno de fisica; Santiago, Chile (26 Dec 1984).

Serrated flow is predicted in a defined deformation-note/strain regime. The prediction is in excellent agreement with recent tests on Al-6061 alloys. (DLC)

**7079 (CONF-841247—2-Abst.) Amorphous Ni-Ti alloys: a new method of synthesis.** Schwarz, R.B. (Argonne National Lab., IL (USA)). 1984. Contract W-31-109-ENG-38. 3p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85002744.

From 4. simposio chileno de fisica; Santiago, Chile (26 Dec 1984).

In order to determine the cause of the amorphization by mechanical alloying, Ni/sub x/Ti/sub 1-x/ ($0.1 < x < 0.8$) were prepared by mechanical alloying and studied using XRD and SEM. Results indicate that amorphization by mechanical alloying proceeds through isothermal solid-state reactions. (DLC)

**7080 (DOE/ER/05246—T2) Investigations of intermetallic alloy hydriding mechanisms. Annual progress report, May 1, 1980-February 28, 1981.** Livesay, B.R.; Larsen, J.W. (Georgia Inst. of Tech., Atlanta (USA). Engineering Experiment Station). 28 Feb 1981. Contract AS05-76ER05246. 72p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85000858.

Microstructural characterization of the hydrogen storage alloys has progressed in the La-Co, La-CoNi alloy system. The techniques employed in microstructural characterization were: optical metallography, x-ray powder pattern analysis, electron microprobe, and scanning electron microscopy with x-ray energy dispersive analysis. The extensive kinetic measurements undertaken during the previous periods indicated that the surface conditions were as important as bulk conditions in obtaining realistic rates. Two types of measurements were employed to monitor surface phenomena. The microbalance was first employed in direct in-situ measurements of normal air poisons and in the characterization of activation. Secondly, magnetic monitoring was used to characterize the surface segregation thought by many observers to be important in poisoning and/or resistance to it.

**7081 (DOE/ER/10107—24) Neutron irradiated mechanical properties of some rapidly solidified austenitic stainless steels.** Harling, O.K.; Lee, M.; Sohn, D.S.; Kohse, G.; Grant, N.J. (Massachusetts Inst. of Tech., Cambridge (USA)). Jun 1984. Contract AC02-78ER10107. 21p. (CONF-840604—30). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003668.

From 12. international symposium on effects of radiation on materials; Williamsburg, VA, USA (18 Jun 1984).

The development of several rapidly solidified 316SS-type alloys for possible application in the first wall of fusion reactors is described. One series is based on titanium additions leading to fine TiC precipitates, and another on oxide dispersion strengthening through addition of yttrium oxide. These materials were irradiated in the High Flux Isotope Reactor of the Oak Ridge National Laboratory at doses up to 34 dpa with associated high helium production of 3100 appM. Post-irradiation mechanical properties derived from the MIT Miniaturized Disk Bend Test are reported. It is concluded that post-irradiation yield strength is not a problem for this class of alloy, but helium embrittlement leading to intergranular fracture is a critical issue. This first generation of rapidly solidified alloys is found to behave similarly to ingot processed material; nevertheless rapid solidification is expected to be a highly useful tool in future efforts to improve grain and grain boundary microstructures. Such improvements may lead to mitigation of radiation-induced helium embrittlement effects and other negative structural factors.

7082 **(DOE/ER/10348—6) Magnetic measurements of the transuranium elements. Progress report, January 1, 1984-December 31, 1984.** Huray, P.G.; Nave, S.E. (Tennessee Univ., Knoxville (USA). Dept. of Physics and Astronomy). 1984. Contract AS05-79ER10348. 42p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85003074.

Measurements of the magnetic properties of dhcp californium-249 metal indicated the presence of three regions of differing magnetic character. Additional measurements are also reported. Magnetic moments and valence states of terbium in $TbF_3$, $BaTbO_3$, and $TbO_{1.8}$ are discussed. Progress on high-field operation of the micro-magnetic susceptometer is reported.

7083 **(DOE/ER/12077—T2) Hydrogen attack of steel. Final report.** Shewmon, P.G. (Ohio State Univ., Columbus (USA). Dept. of Metallurgical Engineering). Mar 1984. Contract AC02-82ER12077. 23p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85002645.

Hydrogen attack in commercial quenched and tempered 2 1/4 Cr - 1 Mo steel was studied. The sensitive dilatometer developed in the past was used. The Nelson curve for 2 1/4 Cr - 1 Mo steel has been updated, and both the curve and rationale for the curve are included in an appendix. (DLC)

7084 **(DOE/ER/13150—T1) Laser studies of chemical dynamics at the gas-solid interface. Progress report.** Cavanagh, R.R.; King, D.S. (National Bureau of Standards, Washington, DC (USA). Center for Chemical Physics). 26 Sep 1984. Contract AI05-84ER13150. 4p. NTIS, PC A02/MF A01; GPO Dep. File Number DE84017590.

Desorption experiments of NO on Ru (001) over a range of rotational states over 40 to 735 $cm^{-1}$ revealed no net polarization effect, and there is no preservation of the molecular orientation during the slow thermal desorption. The Doppler linewidth measurements on NO/Ru (001) require the molecular speed and/or angular flux distribution to depend on rotational state. The NO/Pt (111) system was also studied. (DLC)

7085 **(DOE/ER/71128—T1) Adsorption thermodynamics and surface transport of metal catalyst poisons. Annual report, 1984.** Wise, H. (SRI International, Menlo Park, CA (USA)). 22 Oct 1984. Contract AT03-77ER71128. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003750.

In order to obtain quantitative data on binding energies of adspecies to metal surfaces, our equilibrium studies of sulfur chemisorption have been extended to halogen chemisorption on dispersed metal catalysts. Also, a series of measurements has been initiated on the adsorption of sulfur and carbon and their interaction on single-crystal transition metals. In addition, the relationship between binding energy and activation energy for surface diffusion is being examined by evaluating the diffusion coefficient for sulfur adatom diffusion on single crystal metals as a function of surface coverage, surface orientation, and temperature.

7086 **(DOE/SF/00115—T12) Adsorption thermodynamics and surface transport of metal catalyst poisons.** Wise, H. (SRI International, Menlo Park, CA (USA)). 22 Oct 1984. Contract AM03-76SF00115. 7p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85002868.

Heats of adsorption, formation, and binding energies were determinded for the adsorbed species S, Cl, and Br on $Ni/Al_2O_3$ catalysts. Coadsorbed C and S on Ni are being studied. (DLC)

7087 (INIS-mf—9098, pp 1-2) **Plasma metallurgy in the 1980s.** Reid, K.J. (University of Minnesota, USA). 1984. NTIS (US Sales Only), PC A08/MF A01. File Number TI85780156. (CONF-8403156—Absts.).

From MINTEK 50: international conference on recent advances in mineral science and technology; Sandton, South Africa (26 Mar 1984).

7088 **(INIS-mf—9160) Studies on hot crack formation in welding the material X 10 Ni Cr Al Ti 32 20 with high nickel-containing and similar welding fillers, together with a study of mechanical properties of the welded material.** Eckel, W. (Technische Hochschule Aachen (Germany, F.R.). Fakultaet fuer Bergbau und Huettenwesen). 16 Jun 1982. 204p. (In German). NTIS (US Sales Only), PC A10/MF A01. File Number DE85780159.

Hot crack formation during arc welding of the material X 10 Ni Cr Al Ti 32 20 with high nickel-containing and similar welding filler materials is studied in terms of the dependence on alloy composition and welding parameters. Starting from commercially obtainable welding filler materials, the influence on hot crack formation of different contents of niobium, manganese, molybdenum, silicon and carbon, and of the change in niobium/silicon ratio is determined. Hot cracks are accorded to either of the two categories solidification cracks and melting cracks and the tendency for hot crack formation determined quantitatively as a function of the individual parameters by means of suitable testing procedures developed in accordance with the mechanism of the particular crack type. The causes of crack formation are determined by light microscopic studies on metallographical cuts, raster electron microscopic fracture analysis, microanalyses of cell or grain boundary phases, and X-ray fine structure studies of residual isolates. Results from laboratory studies are compared with actual multi-layer welds of differing welding material composition; here the mechanical properties of the welding material are checked. In addition the stability of the basic material is compared to that of welding materials with high nickel-containing and similar welding fillers.

7089 **(INIS-mf—9164) Properties of tritium in the zirconium alloy, zircaloy 2-diffusion, equilibrium pressure and release.** Kunz, W. (Technische Hochschule Darmstadt (Germany, F.R.). Fachbereich Anorganische Chemie und Kernchemie). 31 Jan 1983. 119p. (In German). NTIS (US Sales Only), PC A06/MF A01. File Number DE85780179.

The properties of tritium in the zirconium alloy, zircaloy 2 were studied. Emphasis was placed on the investigation of T-diffusion in the metal, HT-equilibrium pressure adjustment in the closed system, and rate of release into an argon atmosphere. The following questions were investigated in detail: diffusion of T in the hexagonal $\alpha$-phase of zirconium and zircaloy and parameters which possibly influence this process; diffusion of T in ($\alpha$ + delta) mixed phases in a zircaloy matrix since, in the storage of fuel elements, the hydrogen content exceeds the level of maximum solubility; formation of a HT-partial pressure in a closed system under different temperatures; this situation plays a part for example during intermediate storage of fuel elements in metal containers; rate of release of tritium from zircaloy samples treated in various ways into an argon atmosphere to simulate the storage of spent fuel elements in dry storage containers; diffusion of T in the other two remaining stable elements, Ti and Hf, of the 4sup(th) sub-group to provide comparative measurements for detecting trends within a group of the periodic table.

7090 (INIS-SU—252, pp 41-46) **Void formation in pure aluminium irradiated with high-energetic electron beams and gamma quanta.** Gann, V.V.; Ozhigov, L.S.; Yamnitskij, V.A. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.); Singkh, B.; Leffers, T.; Bil'de-Sorensen, I. (Metallurgy Department, Ris National Lab. (Denmark)). 1983. (In Russian). NTIS (US Sales Only), PC A06/MF A01. File Number TI85780019.

In Radiation damage physics and radiation technology.

The defect formation conditions in aluminium irradiated with a high-energy electron beam and gamma quanta are studied. The microstructure of pure aluminium irradiated up to 0.04 dpa dose is studied. The experimental method is discussed and the results of electron-microscope studies of the void and dislocation structure in irradiated samples are given.

7091 (INIS-SU—252, pp 54-57) **Void formation in ternary alloys under irradiation.** Davydov, L.N.; Spol'nik, Z.A. 1983. (In Russian). NTIS (US Sales Only), PC A06/MF A01. File Number TI85780019.

In Radiation damage physics and radiation technology.

The results of experiments on void formation in ternary alloys under irradiation are generalized. The correlation between the ternary alloy orderliness and void formation intensity under irradiation is established. It is shown that only if all three alloy components in pairs form decomposing binary alloys the process of void formation may be considerably weaker than that in each of three pure metal components. If all three alloy components in pairs form ordered binary alloys void formation may proceed much weaker than in each of three pure metals.

7092 (KEK—82-3, pp 155-162) **Surface properties of aluminum alloy as material for ultrahigh vacuum.** Odagiri, Hitoshi; Maeda, Shigeru; Hashiba, Masao (Hokkaido Univ., Sapporo (Japan). Faculty of Engineering); Ishimaru, Hajime; Oikawa, Hisashi; Kanato, Shigeru. Jun 1982. (In Japanese). NTIS (US Sales Only), PC A09/MF A01. File Number TI85780074. (CONF-8203186—).

From 4. meeting on ultra high vacuum techniques for accelerators and storage rings; Oho, Ibaraki, Japan (12 Mar 1982).

The characteristics of aluminum alloy (2017 alloy) for the vacuum chambers of TRISTAN were studied. Machining, electric discharge machining and chemical polishing were made successively on the samples of the 2017 alloy. The observation of surface state, the analysis of surface composition and high temperature desorption experiment were performed. The measurement of surface roughness with a probe, the observation with a scanning electron microscope (SEM), and the measurement of surface roughness factor (SRF) were carried out as the study of the surface state. The analysis of surface composition was made by the Auger electron spectrometry. It was found that the surfaces of samples treated by discharge machining were rough and have thick oxide layer. When chemical polishing was applied to these samples, the surfaces became smooth, and the oxide layer became thin. By heating the samples to raise the temperature, the desorption of $H_2O$, CO and $CO_2$ was caused. The amount of desorption was in close relation with the SRF.

7093 **(KFK—3721) Annealing behaviour of $Nb_3Ge$ films irradiated at low temperature.** Kraemer, H.P. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Technische Physik). May 1984. 48p. (In German). NTIS (US Sales Only), PC A03/MF A01. File Number DE84752305.

High Tsub(c) $Nb_3Ge$ films prepared by coevaporation have been irradiated by 20 MeV sulfur ions at low temperature (< 20 K). X-ray analysis showed an expansion of the A15 lattice and an increasing degree of amorphicity, while Tsub(c) vs dose decreased from 22 K to 4,3 K with a slight minimum of proportional 70 mK depth at PHI/t approx.= $3x10^{15}$ $cm^{-2}$ before saturation. Films irradiated to doses <= $1,5x10^{15}$ $cm^{-2}$ could be annealed to their preirradiation Tsub(c). In contrast, strong irradiation led to an (X-ray-) amorphous structure, from which Tsub(c) values of only 15-17 K could be recovered, similar to the results obtained for amorphous NbGe films condensed at $LN_2$ temperature. The behaviour of the film resistivity during the heat treatment indicates that for films irradiated with low doses lattice defects anneal, whereas recrystallisation from the amorphous state occurs for high dose damaged films.

7094 **(KFK—3723) Investigations of the atomic structure of amorphous ytterbium-alloys by Moessbauer spectroscopy.** Weschenfelder, D. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Angewandte Kernphysik 1; Karlsruhe Univ. (T.H.) (Germany, F.R.). Fakultaet fuer Physik). Mar 1984. 111p. (In German). NTIS (US Sales Only), PC A06/MF A01. File Number DE84752306.

Atomic-scale structures of the amorphous alloys Yb80X20 (X = Cu, Ag, Au, Pd, Bi) have been investigated with a $^{174}$Yb-Moessbauer source. The distribution of the quadrupole splitting parameters obtained from the analysis of the Moessbauer spectra was compared with the theoretical function for a charge distribution corresponding to dense random packing (DRP) of ions. The atomic structure deduced from the distribution of splitting parameters was consistent with the DRP-model in the amorphous alloys Yb80Cu20, Yb80Ag20, Yb80Au20, Yb80Pd20. In contrast the Moessbauer spectrum of the amorphous alloy Yb80Bi20 showed clear evidence of short range order. This is presumably due to the tendency of bismuth to form covalent bondings.

7095 **(KURRI-TR—231) Present status of studies on special irradiation of materials.** Okuda, Shigeo; Yoshida, Hiroyuki; Nakagawa, Masuo (eds.). (Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst.). Oct 1982. 60p. (In Japanese). (CONF-8201100—1). NTIS (US Sales Only), PC A04/MF A01. File Number DE84703195.

From Study meeting of special irradiation of materials; Kumatori, Osaka, Japan (22 Jan 1982).

The study on radiation damage under severe irradiation condition has been developed in connection with the materials for fusion reactors. This paper is a report of a study meeting concerning the radiation damage. The free migration of interstitial atoms is discussed on the basis of the measurement of internal friction. The point defects of pure iron irradiated by reactor neutrons at low temperature, the 304 stainless steel and FeSiB amorphous alloy irradiated by He ions at room temperature were studied by the measurement of Moessbauer effect. The study on radiation defect by X-ray diffuse scattering is reported. Discussion on the lattice defects in insulating crystals is presented. Sputtering by high density electron excitation, and the behavior of T, D and H atoms in low temperature solids are discussed. Other topics presented in this report are neutron irradiated FCC metal crystals, the radiation effects on cadmium halide crystals and impurity metal ions, and the effects on the properties of semi-conductors by irradiation. The reports on the joint meeting of International Cryogenic Material Conference and Cryogenic Engineering Conference of U.S.A., and the IAEA meeting on the nuclear data for radiation damage and safety are presented.

7096 **(LA-UR—84-3487) Low temperature properties of $CeOs_2$ in the C14 and C15 crystallographic Laves phases.** Torikachvili, M.S.; Yang, K.N.; Maple, M.B.; Meisner, G.P. (California Univ., San Diego, La Jolla (USA). Inst. of Pure and Applied Physical Sciences; Los Alamos National Lab., NM (USA)). 1984. Contract W-7405-ENG-36. 12p. (CONF-841184—19). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003754.

From 30. annual conference on magnetism and magnetic materials; San Diego, CA, USA (27 Nov 1984).

The compound $CeOs_2$ has been prepared in both cubic C15 and hexagonal C14 Laves phases. Measurements of ac and dc magnetic susceptibility, electrical resistivity, and specific heat have been performed on samples of both phases. The C14 phase has been found to exhibit superconductivity with a superconducting transition temperature T/sub c/ of 1.1°K, while the C15 phase does not display superconductivity above 70 mK. Both phases exhibit a slight exchange enhancement of the susceptibility. The curves of resistivity vs temperature for both phases exhibit strong negative curvature which are reminiscent of other valence fluctuation compounds.

7097 **(LA-UR—84-3488) Influence of adsorbed Bi on the chemisorption properties of Pt(111): $H_2$, CO, and $O_2$.** Paffett, M.T.; Campbell, C.T.; Taylor, T.N. (Los Alamos National Lab., NM (USA)). 1984. Contract W-7405-ENG-36. 19p. (CONF-841215—11). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003725.

From 31. national vacuum symposium; Reno, NV, USA (3 Dec 1984).

The growth modes and interactions of vapor-deposited Bi on a clean Pt(111) surface and its effects on the chemisorption of $H_2$, CO, and $O_2$ have been monitored by Auger electron spectroscopy (AES), low-energy electron diffraction (LEED), and thermal desorption mass spectroscopy (TDMS). For submonolayer Bi coverages, LEED patterns were observed to progress with increasing coverage through p(2 x 2), ($\sqrt{3}$ x $\sqrt{3}$)R30°, p(3 x 3), and p(4 x 4) structures. The Bi TDMS and AES data are consistent with absolute coverages of 0.25, 0.33, 0.44, and 0.56, respectively. For submonolayer coverages of this s$^2$p/sup n/-type metal, Bi adatoms are strongly repulsive and maximize their spacing subject to the constraints of the Pt(111) sites. This is to be contrasted with d/sup n/s/sup m/-type metals such as Ag, Cu, and Au on Pt(111), which show attractive interactions and coalesce into 2d islands. In chemis-

orption of small molecules on Pt(111), each Bi adatom blocks about two Pt surface atoms. An ensemble of two adjacent Pt sites is required for both dissociative $H_2$ and molecular $O_2$ adsorption vs one site for CO adsorption; therefore, uptake of the former adsorbates is much more severely attenuated at $\theta$/sub Bi/ increases.

7098 **(LA-UR—84-3497) Recent experimental advances in spin glasses.** Huang, C.Y. (Los Alamos National Lab., NM (USA)). 1983. Contract W-7405-ENG-36. 24p. (CONF-8307145—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003743.

From Workshop on relaxation in disordered systems; Blacksburg, VA, USA (1 Jul 1983).

We present a working definition and a general description of a spin glass. A number of different systems, including metals, semiconductors, and insulators, are discussed. This review presents the current status of experimental spin-glass research with special emphasis on the extent to which the results of this research yield information on spin dynamics. We review the salient features of a series of recent experimental results, published in the past five years, on the susceptibility, magnetization, heat capacity, high-pressure effects, phonon-thermal conductivity, neutron scattering, nuclear, electron, and muon spin resonance. The successful applications of the fractional exponential relaxation function to the frequency dependence of the susceptibility and the time dependence of the thermoremanent magnetization are demonstrated. Concerning the possible existence of the phase transition at the susceptibility cusp temperature, we summarize the experimental evidences. 179 references, 31 figures.

7099 **(LBL—18582) Electronic structure and optical spectroscopy of f/sup n/ ions and compounds.** Edelstein, N. (Lawrence Berkeley Lab., CA (USA)). Oct 1984. Contract AC03-76SF00098. 50p. (CONF-8409181—1). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85003469.

From NATO advanced study institute on fundamental and technological aspects of Organo-F-Element chemistry; Acquafredda di Maratea, Italy (10 Sep 1984).

The electronic structure of the actinides and lanthanides is reviewed. The assignments of f/sup n/ spectra in the visible and near infrared regions and the fitting of these spectra to the parameters of a phenomenological Hamiltonian are discussed. From the wavefunctions obtained from this type of analysis, magnetic susceptibility data can be calculated. Examples are given from recent work on $Cp_3Ln.L$ ($Cp=C_5H_5$, L=base) compounds. Slater and spin-orbit parameters obtained from the analyses of free ion spectra and from the same ion in compounds are compared.

7100 **(MLM—3200) Chemical cleaning of 304 and 304-L stainless steel surfaces by the nitradd passivation process.** Johnson, T.M. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 27 Nov 1984. Contract AC04-76DP00053. 10p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85003714.

A chemical cleaning process was established at Mound to prepare 304 and 304-L stainless steel surfaces for welding operations. This process was adapted from an existing production procedure used at the Rocky Flats Plant. The results of the two processes were compared by means of Auger Electron Spectroscopy (AES). The AES data showed that the Rocky Flats process and the process established at Mound produce comparable results. Consequently, the Mound process is a viable one and is being used to prepare specimens for welding experiments.

7101 **(ORNL—6067) Initial development of nickel and nickel-iron aluminides for structural uses.** Liu, C.T.; Jemian, W.; Inouye, H.; Cathcart, J.V.; David, S.A.; Horton, J.A.; Santella, M.L. (Oak Ridge National Lab., TN (USA)). Aug 1984. Contract AC05-84OR21400. 62p. NTIS, PC A04/MF A01; GPO Dep. File Number DE84016641.

Initial development of ductile nickel and nickel-iron aluminides has concentrated on boron-doped $Ni_3Al$ alloyed with iron and other elements. The aluminide can dissolve no more than 15 at. % Fe, beyond which formation of both transformed B2 phase ($\beta'$) and disordered fcc phase ($\gamma$) is observed. Nickel-iron aluminides were tensile tested as a function of temperature. Iron additions strengthen $Ni_3Al$ effectively at temperatures to 850°C. The yield stress of the nickel-iron aluminides increases with test temperature and reaches a maximum around 650°C. The high-temperature strength of the aluminides can be further improved by alloying with less than 2 at. % Hf. Hafnium-modified aluminides are stronger than commercial superalloys, including some cast superalloys. Hot corrosion behavior of nickel-iron aluminides was determined in quartz capsules and in a circulating loop system containing a supply of $CaSO_4$ at temperatures to 871°C (1600°F). The combined results from these tests showed the dependence of sulfidation on oxygen partial pressure and verified that the sulfidation attack of aluminides in capsule tests was caused by oxygen depletion in a closed system with a limited supply of oxygen. The aluminides exhibited superior oxidation resistance in air at temperatures to 1100°C. The ductile aluminides are prone to hot cracking during welding. However, they can be electron beam welded successfully under closely controlled conditions. Boron content and welding speed affect the weldability of the aluminides.

7102 **(ORNL/TM—9115) Steel castings by the electroslag casting technique.** Sikka, V.K.; Mitchell, A. (Oak Ridge National Lab., TN (USA)). Oct 1984. Contract AC05-84OR21400. 28p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85003812.

Electroslag casting facilities in Canada and the United States were reviewed. Several valve body castings of 2 1/4 Cr-1 Mo, 9 Cr-1 Mo, and 18% Cr-8% Ni(Mo) steels were made at the University of British Columbia facility. These castings were examined for surface finish, chemical segregation, and macrostructure in the as-cast condition and after various heat treatments. Castings were subjected to tensile, Charpy impact, and creep testing. Results of these tests were compared with similar data on wrought material and, where applicable, with data on sand castings. 22 figures.

7103 **(ORNL/TM—9307) Effect of tempering on the strength and toughness of 2 1/4 Cr-1 Mo steel weldments.** Swindeman, R.W.; Nanstad, R.K.; King, J.F.; Stelzman, W.J. (Oak Ridge National Lab., TN (USA)). Oct 1984. Contract AC05-84OR21400. 43p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85003818.

Hardness, tensile, and Charpy V-notch impact tests were performed on samples prepared from submerged-arc weldments of 2 1/4 Cr-1 Mo steel. The intent was to explore the effect of tempering on the strength and ductility of the alloy in order to assess the potential for developing a high-strength alloy for gasifier pressure vessel service to 300°C. Results indicated that good weld metal strength and toughness could be achieved. Limited work on the heat-affected zone of the base metal did not reveal any major problems. We concluded that qualification of a quenched-and-tempered version of 2 1/4 Cr-1 Mo steel with ultimate strength in the range 620 to 758 MPa (90 to 110 ksi) will be difficult for welded gasifier pressure vessels because of a narrow time-temperature tempering window. A minimum ultimate strength requirement of 585 MPa (85 ksi), however, would be much easier to achieve because of the larger window.

7104 **(PB—84-219393) Nippon Steel technical report number 22, 1983.** (Nippon Steel Corp., Tokyo). Dec 1983. 133p. NTIS, PC E07/MF E01.

See also PB84-219401 through PB84-219443 and PB84-131788.

Contents: Development of the continuous on-line control (CLC) process for manufacturing high-quality steel plate by controlled cooling; Properties of nuclear reactor pressure vessel steel plate (ASTM A 533 B Cl. 1); Properties of ASTM A387-22 (2-1/4Cr-1Mo) steel plates produced by BOP; Development of high-manganese steels; Low C-Cu-P type superior atmospheric corrosion resistant steel for welded structures; Trends and material requirements of high-temperature equipment; Embrittlement of low-alloy steel during service at elevated temperatures; Heavy stainless steel plates for fast breeder reactors; Service performance of stainless steels for high-temperature use; Pressure vessel plates, high strength steels for intermediate and moderate temperature service; Rifled ERW boiler tubing; Abstracts from the Seitetsu Kenkyu, series No. 309 and 311.

7105 **(PNL-SA—12097) Heavy ion induced crystallization in amorphous phases.** Brimhall, J.L. (Pacific Northwest Lab., Richland, WA (USA)). Jul 1984. Contract AC06-76RL01830. 15p. (CONF-840760—16). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003114.

From Ion beam modification of materials conference; Ithaca, NY, USA (16 Jul 1984).

Bombardment of an amorphous phase with high energy, heavy ions both lowered the crystallization temperature and changed the crystallization mode compared to annealing without concurrent ion bombardment. Ion bombardment caused a direct transformation to the equilibrium crystalline phase or phases from the amorphous phase with no intermediate phase formation. These radiation effects were observed in three sputter-deposited, amorphous alloys: $Fe_{81}Cr_{17}$ $Ni_8W_{14}$, $Ni_{50}Mo_{50}$ and $Ni_{45}Ti_{55}$. The lowering of the crystallization temperature is attributed to an increase in the excess free volume in the amorphous structure by the irradiation which consequently increases atomic mobility. This is analogous to radiation-enhanced diffusion phenomenon in crystalline structures. The high degree of localized atom displacements in cascades induced by the heavy ions should also provide sufficient activation to form the equilibrium phases without the necessity of forming metastable phases. No metastable phases were observed during annealing of amorphous $Ni_{45}Ti_{55}$; therefore, ion bombardment had little effect on the crystallization mode in this particular alloy.

7106 **(SAND—84-1286C) Effect of implantation species on the tribological response of stainless steel surfaces.** Pope, L.E.; Picraux, S.T.; Follstaedt, D.M.; Knapp, J.A.; Yost, F.G. (Sandia National Labs., Albuquerque, NM (USA)). 1984. Contract AC04-76DP00789. 23p. (CONF-841116—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003530.

From ASM conference on coatings and bimetallics for energy systems and chemical process environments; Hilton Head Island, SC, USA (13 Nov 1984).

The friction and wear properties of 304 and 15-5 PH stainless steels which were ion implanted with P and with P plus C have been examined and are compared with the properties of the same steels implanted with N and with Ti plus C. While benefits are obtained with the P and the P plus C implantation treatments, the N and the Ti plus C treatments give greater reductions in wear which extend to more severe wear regimes; with Ti plus C, friction is also reduced. Transmission electron microscopy shows that the P and the P plus C implantations (with 20 to 30 at. % metalloid concentrations) produce surface alloys with amorphous phases, as do Ti plus C treatments (approximately 20 at. % each). The greater benefits obtained with the Ti plus C amorphous phase imply that this phase is mechanically superior to the amorphous phase with P plus C, even though the latter has been shown to have excellent mechanical properties when produced by melt quenching. Ti and C were selected for implantation into a 15-5 PH discriminator wheel of an electromechanical device for comparison with standard solid film lubrication ($MoS_2$). In comparison to a solid film lubricated wheel, the implanted wheel (unlubricated) performed equally well with respect to time of operation, number of cycles and tolerance control; in addition the implanted wheel produced less debris. An alternate ion beam method was used to add high surface concentrations to control fretting corrosion and debris generation of a journal bearing in a different electromechanical device: a sputter-deposited Au film (50 nm) on 15-5 PH stainless steel was ion bombarded with 300 keV $Xe^+$. This treated surface was compared with a sputtered Au film without ion beam treatment, with electrodeposited Au and with a solid lubricating film. The ion mixed Au surface bearings had the least corrosion and debris.

7107 **(SERI/TP—255-2492) Exploratory corrosion tests on alloys in molten salts at 900°C.** Coyle, R.T.; Thomas, T.M.; Lai, G.Y. (Solar Energy Research Inst., Golden, CO (USA); Cabot Corp., Kokomo, IN (USA)). Oct 1984. Contract AC02-83CH10093. 17p. (CONF-8409179—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE85000511.

From American Institute of Mining, Metallurgical and Petroleum Engineers conference; Detroit, MI, USA (17 Sep 1984).

Exploratory corrosion tests were conducted on 16 commercial alloys in carbonate, chloride, and hydroxide molten salts at 900°C for up to three weeks. Corrosion information, including weight change, observations of the coupons, metallographic examination, and evaluation of the corrosion product by SEM, was obtained on the coupons exposed to these salts. These tests indicated that a number of the alloys showed significant resistance to metal loss in the carbonate molten salt with corrosion rates on the order of several millimeters per year. The corrosion product is an interpenetrating structure of metal from the more noble alloy ingredients and of an oxide made up of the reaction between melt components and oxidizable metals from the alloy.

7108 **(UCID—20270) Repair brazing procedure for water-cooled copper skip-shields for L.I.S. program.** Witherell, C.E. (Lawrence Livermore National Lab., CA (USA)). 26 Nov 1984. Contract W-7405-ENG-48. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004453.

This report outlines the approach and procedure devised for repair-brazing the subject parts. This need arose when the parts furnace-brazed by an outside fabricating facility could not be made leak-tight.

7109 **(UCRL—89988) Selection of candidate canister materials for high-level nuclear waste containment in a tuff repository.** McCright, R.D.; Weiss, H.; Juhas, M.C.; Logan, R.W. (Lawrence Livermore National Lab., CA (USA); Michigan Univ., Ann Arbor (USA)). Nov 1983. Contract W-7405-ENG-48. 43p. (CONF-840405—14). NTIS, PC A03/MF A01; GPO Dep. File Number DE85003567.

From NACE corrosion '84 international forum and exhibition; New Orleans, LA, USA (1 Apr 1984).

A repository located at Yucca Mountain at the Nevada Test Site is a potential site for permanent geological disposal of high-level nuclear waste. The repository can be located in a horizon in welded tuff, a volcanic rock, which is above the static water level at this site. The environmental conditions in this unsaturated zone are expected to be air and water vapor dominated for much of the containment period. Type 304L stainless steel is the reference material for fabricating canisters to contain the solid high-level wastes. Alternative stainless alloys are considered because of possible susceptibility of 304L to localized and stress forms of corrosion. For the reprocessed glass wastes, the canisters serve as the recipient for pouring the glass with the result that a sensitized microstructure may develop because of the times at elevated temperatures. Corrosion testing of the reference and alternative materials has begun in tuff-conditioned water and steam environments. 21 references, 8 figures, 8 tables.

7110 **Neutron scattering investigations of $\alpha$-uranium in the charge-density-wave state.** Smith, H.G.; Lander, G.H. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Physical Review [Section] B: Condensed Matter;* **30**: No. 10, 5407-5415(15 Nov 1984). Contract W-31-109-ENG-38.

Below 43 K, $\alpha$-uranium (the orthorhombic phase stable below 600 °C) develops an incommensurate charge-density wave (CDW) that has a profound effect on almost all physical properties of this element. Previous work at Oak Ridge National Laboratory and the Institut Laue-Langevin has characterized the phonon dispersion curves and various properties of the periodic distortions of the atomic structure. In this paper we review some of these results and present new information giving further details of the CDW state, in particular the temperature and pressure dependence of both the elastic and inelastic (precursor phonon) scattering. Suggestions for new experiments, including those using other techniques, are presented.

7111 **Fermi surface and optical properties of a Ag-Au alloy.** Nautiyal, T.; Auluck, S. (Physics Department, University of Roorkee, Roorkee 247667, India). *Physical Review [Section] B: Condensed Matter;* **30**: No. 10, 6165-6167(15 Nov 1984). Contract W-7405-ENG-82.

An interpolation scheme is used to obtain a good fit to the Fermi-surface data for a AgAu alloy. We are forced to make changes in some of the d-band parameters. Using our set of parameters, we have calculated the changes in the imaginary part of the

dielectric function $\Delta\epsilon_3(\omega)$ upon alloying. We compare our results, obtained by taking matrix elements to be unity, with the experimental data.

7112 **X-ray tests of multilayer coated optics.** Golub, L.; Spiller, E.; Tatchyn, R.; Bartlett, R.J.; Hockaday, M.P.; Kania, D.R.; Trela, W.J. (Harvard-Smithsonian Center for Astrophysics, 60 Garden Street, Cambridge, Massachusetts 02138). *Applied Optics;* **23**: No. 20, 3529-3533(15 Oct 1984).

The performance at soft x-ray wavelengths of multilayer mirrors fabricated with absorber layers of transition metals in the Ni to V series has been tested. Tests were performed at the Stanford Synchrotron Radiation Laboratory, using a test chamber which allowed reflectivity measurements to be performed at angles from near-grazing to near-normal incidence. Useful reflectivity data were obtained at energies from 80 eV to the carbon edge (~250 eV). Some of the materials which were found to perform well at coarse 2d spacings were later tested in finer multilayers to evaluate the influence of interlayer surface roughness on reflectivity.

7113 **Calculated surface electronic structure of ferromagnetic iron and the ferromagnetic ordered iron-cobalt alloy.** Victora, R.H.; Falicov, L.M.; Ishida, S. (Materials and Molecular Research Division, Lawrence Berkeley Laboratory, Berkeley, California 94720 and Department of Physics, University of California, Berkeley, California 94720). *Physical Review [Section] B: Condensed Matter;* **30**: No. 7, 3896-3902(1 Oct 1984).

The electronic and magnetic properties of the (100) and (110) surfaces of ferromagnetic iron and the ferromagnetic iron-cobalt ordered alloys are calculated self-consistently. It is found that (a) in pure bcc iron the spin polarization increases from a bulk value of 2.12 to 2.90 at the (100) surface and to 2.55 at the (110) surface; (b) the ordered FeCo alloy has a bulk spin polarization of 2.66 for the Fe constituent and 1.78 for the Co constituent, compared with 2.12 and 1.56 for the respective pure elements; (c) in the (100) surfaces of ordered FeCo, the spin polarizations are 2.95 for Fe and 2.03 for Co; (d) the (110) surface of ordered FeCo exhibits spin polarizations of 2.75 for Fe and 1.86 for Co; (e) an atomic (110) overlayer of Fe on ordered FeCo produces a surface spin polarization of 2.63 and 2.67 for the two inequivalent Fe atoms. Agreement with available experimental data is excellent. All results can be successfully interpreted based on the saturation magnetization of Co, the relatively weak electron-electron interaction of Fe, and the surface narrowing of the electronic d band.

7114 **Initial stages of oxidation of the $Pt_3Ti(111)$ and (100) single crystal surfaces.** Bardi, U.; Ross, P.N. (Materials and Molecular Research Division, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **2**: No. 4, 1461-1470(Oct 1984).

The process of segregation of titanium oxides onto the surface of $Pt_3Ti$ upon the exposure to oxygen at different pressures and temperatures was studied by LEED and AES. Oriented [111] and [100] monocrystals as well as polycrystals were synthesized for study. Qualitatively similar behavior was observed with all three types of surfaces, with three stages of oxidation observed on each surface. A layer of stoichiometry close to TiO segregated onto the surface in the initial stage of oxidation, depleting the subsurface region of the alloy in Ti. The TiO formed a compact, epitaxial monolayer which completely blocked the metallic surface for chemisorption by carbon monoxide. Further oxidation caused formation of a multilayer of TiO/sub 1.2/, an oxide with an orthorhombic structure derived from TiO by removing Ti atoms to form an ordered vacancy lattice. Finally, oxidation at the relatively extreme conditions of atmosphere pressure at high (>1000 K) temperature caused formation of thick $TiO_2$ (rutile) overlayers.

7115 **The effects of deposits of CaO, $CaSO_4$, and MgO on the oxidation of several $Cr_2O_3$-forming and $Al_2O_3$-forming alloys.** Chiang, K.T.; Meier, G.H.; Perkins, R.A. (RCA, Lancaster, PA). *Journal of Materials for Energy Systems;* **6**: No. 2, 71-86(Sep 1984).

The influence of deposits of CaO, $CaSO_4$, and MgO on the oxidation behavior of a number of $Cr_2O_3$-forming and $Al_2O_3$-forming alloys was studied over the temperature range 850° to 1050°C. Deposits of CaO were observed to accelerate the degradation of $Cr_2O_3$-forming alloys in oxygen or air by two mechanisms: (1) accelerated $CrO_3$ evaporation over the entire temperature range studied; and (2) liquid formation by reaction between CaO and $Cr_2O_3$ at temperatures above 1000°C which resulted in catastrophic corrosion. The reaction of transient $Cr_2O_3$ with CaO also resulted in liquid formation on Ni-Cr-Al and Co-Cr-Al alloys, which are nominally $Al_2O_3$-formers, and produced severe corrosion. Deposits of $CaSO_4$ did not accelerate corrosion by either mechanism. Deposits of MgO enhanced degradation by mechanism (1) but not by mechanism (2), since there are no low melting phases in the MgO-$Cr_2O_3$ system. Chromium-free Ni-Al alloys resisted attack by either mechanism.

7116 **Strain distributions in a type 316/16-8-2 stainless steel weldment during cyclic loading.** Korth, G.E.; Harper, M.D. (EG and G Idaho, Inc., Idaho Falls, ID). *American Society of Mechanical Engineers, [Paper];* **84-PVP-26**: 6(Jun 1984). (CONF-840647—).

From ASME pressure vessel and piping conference; San Antonio, TX, USA (17 Jun 1984).

Test specimens were cut from a 25-mm thick Type 316 stainless steel plate butt welded with 16-8-2 filler wire. The specimens were oriented transverse to the weld seam and contained base metal, heat-affected zone (HAZ), and weld metal in the gage section. Strain-controlled cyclic loading was imposed across the heterogeneous weldment while local strains at various points within the gage section were continuously monitored. Results show that strains at the local points can vary markedly from the average strain of the composite section. Strain concentrations occurred in the softer base metal which led to failure much sooner than the composite strain would indicate. However, when the maximum strain range from a local area was compared to baseline data, the life correlation was very good.

7117 **Residual stress measurements on thick plate low-alloy steel narrow gap weldments by x-ray diffraction.** Rund, C.O.; DiMascio, P.S.; Pangborn, R.N.; Snoha, D.J. (The Pennsylvania State University, Materials Research Laboratory and Department of Engineering Science and Mechanics, University Park, Pennsylvania). *American Society of Mechanical Engineers, [Paper];* **84-PVP-128**: 6(Jun 1984). (CONF-840647—).

From ASME pressure vessel and piping conference; San Antonio, TX, USA (17 Jun 1984).

A unique x-ray diffraction instrument for residual stress measurement has been developed that provides for speed, ease of measurement, accuracy, and economy of surface stress measurement. Application of this instrument with a material removal technique, e.g., electropolishing, has facilitated detailed, high resolution studies of three-dimensional stress fields. This paper describes the instrumentation and techniques applied to conduct the residual stress measurement and presents maps of the residual stress data obtained for the surfaces of a heavy 2 1/4 Cr 1 Mo steel plate weldment.

7118 **The mechanical behavior of a superalloy in a molten nitrate salt environment.** Goods, S.H. (Sandia National Laboratories, Livermore, CA). *American Society of Mechanical Engineers, [Paper];* **84-PVP-126**: 10(Jun 1984). (CONF-840647—).

From ASME pressure vessel and piping conference; San Antonio, TX, USA (17 Jun 1984).

The influence of a molten nitrate salt (60 /SUP w/ / $_0NaNO_3$-40 /SUP w/ / $_0KNO_3$) environment on the mechanical properties of Alloy 800 has been investigated through a series of slow strain rate and fatigue crack growth experiments. At 600°C and at strain rates between $2 \times 10^{-7}$sec$^{-1}$ and $1 \times 10^{-5}$sec$^{-1}$ no appreciable loss in strength or in ductility, as measured by reduction in area, was observed for specimens exposed to the salt environment compared to control specimens tested in air at the same temperature and strain rates. Nearthreshold crack growth rates were found to be marginally influenced by the salt environment. These results are discussed along with the influence of deformation on the

structure of the oxide films formed due to exposure to the salt environment are discussed.

7119 **An improved multiaxial creep-rupture strength criterion.** Huddleston, R.L. (Engineering Technology Division, Oak Ridge National Laboratory, Oak Ridge, TN). *American Society of Mechanical Engineers, [Paper];* **84-PVP-106**: 9(Jun 1984). (CONF-840647—).

From ASME pressure vessel and piping conference; San Antonio, TX, USA (17 Jun 1984).

An improved strength model is developed for predicting creep rupture under multiaxial stress states. The new model incorporates four stress parameters and distinguishes between life under tensile versus compressive stress states. Assessments of the new model based on experimental biaxial creep-rupture data for type 304 stainless steel tested at 593°C show the new model to be significantly more accurate than the classical criteria of Mises, Tresca, or Rankine.

7120 **Fatigue of bainitic 2 1/4 Cr-1 Mo steel weldments at 482°C.** Swindeman, R.W.; Williams, B.C. (Metals and Ceramics Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee). *American Society of Mechanical Engineers, [Paper];* **84-PVP-57**: 11(Jun 1984). (CONF-840647—).

From ASME pressure vessel and piping conference; San Antonio, TX, USA (17 Jun 1984).

Low-cycle fatigue tests were performed on specimens machined from weldments of 2 1/4 Cr-1 Mo steel. Section thicknesses were in the range 150 to 300 mm, and welds were produced by the submerged arc (SA) and the narrow-groove hot-wire gas tungsten arc (NG-HW-GTA) processes. Test specimens included hourglass and uniform-gage specimens machined from base metal, weld metal, or combinations including the heataffected zone (HAZ) in the testing section. Most specimens were postweld heat treated for 28 h at 690°C before testing. Poor fatigue behavior was observed in some weldments because of strain concentrations in samples that contained HAZ and porosity in samples that were entirely weld metal. Porosity was much greater in the NG-HW-GTA welds than in the SA welds. The most severe HAZ and porosity effects were equivalent to a factor of two in strain concentration. Time-dependent effects were examined in a few tests by introducing hold periods up to 1 h at the compressive or tensile strain limit of each cycle. Although such effects did reduce the fatigue life, the reduction was no more severe than that caused by the strain concentration in the HAZ or by the porosity. The longest hold-time tests showed some internal cavitation; however, most failures in sound material were produced by a surface oxide cracking mechanism, which has been extensively examined in annealed 2 1/4 Cr-1 Mo steel.

7121 **Fatigue threshold studies in Fe, Fe-Si, and HSLA steel: Part II. Thermally activated behavior of the effective stress intensity at threshold.** Yu, W.; Esaklul, K.; Gerberich, W.W. (Univ. of Minnesota, Minneapolis, MN). *Metallurgical Transactions, [Section] A: Physical Metallurgy and Materials Science;* **15A**: No. 5, 889-900(May 1984).

It is shown that closure mechanisms alone cannot fully explain increasing fatigue thresholds with decreasing test temperature. Implications are that fatigue crack propagation near threshold is a thermally activated process. The effective threshold stress intensity correlate to the thermal component of the flow stress. A fractographic study of the fatigue surface was performed. Water vapor in room air promotes the formation of oxide and intergranular crack growth. At lower temperatures, a brittle-type cyclic cleavage fatigue surface was observed but the ductile process persisted even at 123 K. Arrest marks found on all three modes of fatigue crack growth suggest that fatigue crack growth controlled by the subcell structure near threshold. The effective fatigue threshold may be related to the square root of (one plus the strain rate sensitivity).

7122 **Fatigue threshold studies in Fe, Fe-Si, and HSLA steel: Part I. Effect of strength and surface asperities on closure.** Gerberich, W.W.; Esaklul, K.; Yu, W. (Univ. of Minnesota, Minneapolis, MN). *Metallurgical Transactions, [Section] A: Physical Metallurgy and Materials Science;* **15A**: No. 5, 875-888(May 1984).

The fatigue threshold increased as the temperature decreased from 300 K to 123 K. A closure was observed with the magnitude of closure stress intensity higher at lower temperature. The closure stress intensity correlated with yield stress and grain size. By considering reverse slip, geometry, and oxide-induced closure simultaneously, a model proposed and compared to the data from this study and the literature. All three mechanisms of residual plasticity, geometrical asperity, and oxide formation are shown to be relevant to the observed closure phenomena in this study.

7123 **Influence of stress on $H_2S$ adsorption on iron.** Baer, D.R.; Jones, R.H.; Thomas, M.T. (Battelle Pacific Northwest Laboratory, Richland, WA). *Metallurgical Transactions, [Section] A: Physical Metallurgy and Materials Science;* **15A**: No. 5, 853-860(May 1984).

The effect on stress on the rate of $H_2S$ adsorption on iron has been examined using Auger Electron Spectroscopy (AES). A specially designed ultra high vacuum straining stage allowed samples to be cleaned, aligned, strained, and dosed with $H_2S$ in front of the AES analyzer. An applied stress increased the $H_2S$ adsorption rate on annealed zone-refined iron by as much as 60 percent. This increase was in spite of the high sticking coefficients reported 0.3 to 1.0. Stress-enhanced adsorption could be a factor for environmentally sensitive properties such as crack growth and stress corrosion. Surface damage produced by ion sputtering also influenced the $H_2S$ adsorption rate and comparisons have been made between the effect of ion damage and stress on adsorption.

7124 **Microstructural changes produced in a multifilamentary Nb-Ti composite by cold work and heat treatment.** West, A.W.W.; Larbalestier, D.C. (University of Wisconsin-Madison, Madison, WI). *Metallurgical Transactions, [Section] A: Physical Metallurgy and Materials Science;* **15A**: No. 5, 843-852(May 1984).

The microstructural changes produced by cold work and heat treatment of a full-scale filamentary Nb-Ti superconducting composite have been investigated using transmission electron microscopy. Full details of the processing conditions used are given, and both longitudinal and transverse sections of the microstructure have been examined. Heat treatments are found to give a complex precipitate morphology. The precipitates produced by heat treatment at 648 K (375°C) to range from a thin boundary film 3 to 6 nm thick through small ellipsoidal precipitates to larger equiaxed precipitates. The larger precipitates are identified as a-Ti. Cold drawing refines the microstructure; an even greater degree of refinement was observed when intermediate heat treatments were applied. The observations show a strong interdependence between the cold-worked substructure and precipitate morphology in heat-treated and heavily cold-worked composites.

7125 **The high temperature oxidation of metals forming cation-diffusing scales.** Rapp, R.A. (Ohio State Univ., Columbus, Ohio). *Metallurgical Transactions, [Section] A: Physical Metallurgy and Materials Science;* **15 A**: No. 5, 765-782(May 1984).

In the past two decades, researchers have repeatedly shown that Wagner's classical parabolic scaling theory has a limited temperature regime of applicability. In particular, at intermediate temperatures-generally the highest permitted for long-lived engineering systems-parabolic oxidation rates are higher and activation energies are lower than those values extrapolated from higher temperatures where lattice-diffusion-limited growth occurs. Short-circuit cation diffusion via scale grain boundaries and dislocations supports oxidation in the intermediate temperature regime, and scale growth at the scale/gas interface takes place at ledges provided by screw dislocations intersecting the metal. In situ observations of scale growth in a hot-stage environmental scanning electron microscope have provided insight into scale growth mechanisms and the formation of nonplanar oxidation products: whiskers, pyramids, and pits. Specific reference is made to the evolution of oxidation product morphologies for copper, nickel, iron, and chromium.

7126 **Metallography can be colorful.** Grey, R.J. (Oak Ridge National Laboratory, Oak Ridge, TN). pp 16-17 of Shaping our energy future. Knoxville, TN, USA; LTM Consultants (1984). (CONF-840229—).

From 11. annual WATTec conference and exposition - shaping our energy future; Knoxville, TN, USA (21 Feb 1984).

Abstract only.

Each day we use the colors of nature as major guides to the identification of flowers, trees, birds, insects, etc. The application of color techniques in metallography offers an extension of our interpretations of metals, alloys, and ceramics. For the materials engineer, the use of color metallography offers an exciting approach in the understanding of the crystalline state. For the non-engineer, the aesthetic appeal of the colorful microstructures can be related to abstract art and can extend the understanding and appreciation of some materials which might be used every day.

7127 **Metallography in microanalysis.** Henson, H.; Henson, T.J. (Union Carbide Corp., Oak Ridge, TN). pp 17 of Shaping our energy future. Knoxville, TN, USA; LTM Consultants (1984). (CONF-840229—).

From 11. annual WATTec conference and exposition - shaping our energy future; Knoxville, TN, USA (21 Feb 1984).

Abstract only.

The use of metallography in support of other microanalytical and surface analytical techniques is finding wide application in materials studies carried on at Oak Ridge National Laboratory and Oak Ridge Gaseous Diffusion Plant. Selected examples of work done at both facilities using electron microprobe analysis, scanning electron microscopy, x-ray and Auger electron spectroscopy as well as metallography in both traditional and unusual roles will be described. The major objective of this paper is to illustrate the strength of a combined approach to materials problems using these techniques; however, some cautionary notes regarding metallographic and microanalytical interaction will be included.

7128 **Effect of silica support texture and anion of impregnating solution on Ru dispersion and on Ru-Cu interaction.** Haller, G.L.; Resasco, D.E.; Wang, J. (Yale Univ., New Haven, CT). *Journal of Catalysis;* **84**: No. 2, 477-479(Dec 1983).

Three sets of Ru and Ru-Cu catalysts were prepared by different methods and were placed on different types of silica supports which have been used by various groups of experimentalists. The initial reduction temperature (773 and 723°K) and the volume of solution/g of support were judged not to be critical preparation variables in this study - the ethane hydrogenation activity. Little evidence exists for Ru-Cu interaction in the $H_2$ chemisorption. The anions of the impregnating solution and the texture do not directly affect Cu-Ru interactions, but may do so indirectly by their effect on the dispersion of Ru. Apparently nitrate complexes of Ru undergo stronger ion exchange on silica than do chloride containing complexes. The resulting better dispersion of Ru with its accompanying segregation decreases the likelihood of Ru-Cu interaction. This interpretation is undergoing further study. 2 figures, 1 table.

7129 **Development of a ferritic consumable for welding grain-refined Fe-12Ni-0.25Ti to retain toughness at 4.2K.** Kim, H.J.; Morris, J.W. Jr. (Lawrence Berkeley Lab., CA). *Welding Journal, Research Supplement;* 210s-219s(Aug 1983). Contract W-7405-ENG-48.

Multipass gas tungsten arc welding (GTAW) has been adapted for welding grain-refined Fe-12Ni-0.25Ti steel with a matching ferritic 14% filler metal. The weld is made as a multipass weldment using a single V-groove preparation at heat inputs from 7-17 kJ/cm (18-43 kJ/in.). The ferritic weldment has a strength roughly matching that of the base metal and exhibits excellent toughness both in the weld metal and in the heat-affected zone at temperatures as low as liquid helium temperature (4.2 K, i.e., -452°F). The excellent toughness is attributed to two factors: the chemical cleanliness of the GTAW deposit, and the refined microstructure of the weldment and the retention of fine microstructure in the heat-affected zone. Grain refinement is accomplished by the sequential rapid thermal cycles experienced by the material during multipass GTAW welding.

7130 **Rate-dependent plastic flow in polycrystalline silver at ambient temperature.** Kassner, M.E.; Mukherjee, A.K. (Lawrence Livermore National Lab., CA). *Scripta Metallurgica;* **17**: 714-744(1983). Contract W-7405-ENG-48.

A study on the controlling mechanism for plastic flow of polycrystalline silver is reported. Strain-rate change tests were performed on annealed silver and were used to determine the variation of product of activation area and the Burgers vector with strain at ambient temperature. The results are supportive of the intersection of dislocations as the controlling mechanism for plastic flow at low temperatures.

7131 **Electrical resistivity of the Na-Pb system: measurements and interpretation.** Calaway, W.F.; Saboungi, M.L. (Argonne National Lab., IL). *Journal of Physics F: Metal Physics;* **13**: 1213-1223(1983).

Electrical resistivity measurements for Na-Pb alloys are presented over the whole composition range and in the temperature interval 600 to 823 K. The variations of the electrical resistivity and its temperature dependence with alloy composition exhibit interesting features, i.e. a maximum and a negative minimum respectively, around the composition corresponding to that of $Na_4Pb$. The results are discussed in terms of the Faber-Ziman model and the Mott intuitive approach. It is suggested that a tendency towards a metal-non-metal transition exists which leads to a partial charge transfer from one component of the alloy to the other to form non-metallic species.

7132 **Contrast between mode I and mode III fatigue crack propagation under variable amplitude loading conditions.** Nayeb-Hashemi, H.; Suresh, S.; Ritchie, R.O. (Northeastern Univ., Boston, MA). *Materials Science and Engineering;* **59**: L1-L5(1983). Contract AC03-76SF00098.

It is well established that variable amplitude loading in the form of single spike or block overloads can result in pronounced transient retardations and even complete crack arrest during modeI fatigue crack propagation. The origin of such effects has been ascribed to one or more of the following mechanisms: crack tip-yield zone interactions, crack tip blunting, branching, crack closure due to residual plastic strains, fracture surface microroughness, and corrosion deposits. Cyclic torsion tests on circumferentially notched cylindrical bars of an ASTM A469 rotor steel (yield strength, 621 MPa) at zero mean torque (stress ratio R = -1), reported. It was found that transient growth rate behavior for mode III cracks following single overloads and high-low block loading sequences, was almost exactly opposite to that commonly observed under mode I loading. The behavior of mode III and mode I fatigue cracks subjected to single positive overloads is shown.

7133 **Relative effects of S, Sb and P on the intergranular fracture of iron and nickel tested at cathodic potentials.** Jones, R.H.; Bruemmer, S.M.; Thomas, M.T.; Baer, D.R. (Pacific Northwest Lab., Richland, WA). pp 895-900 of Atomistics of Fracture. Latanision, R.M.; Pickens, J.R. (eds.). New York, NY, USA; Plenum Publishing Corporation (1983).

Evidence that S, Sb and P participate in the embrittlement of iron and nickel tested at cathodic potentials by decreasing the critical intergranular fracture stress or by enhancing hydrogen permeation was examined. Sulfur was found to affect iron and nickel similarly, probably by both mechanisms. Antimony's primary effect was to reduce the critical intergranular fracture stress of iron. An effect is seen in nickel but a mechanism could not be assigned. Phosphorus was found to have a negligible effect in both iron and nickel.

7134 **Contributions to the heat capacity of alpha (HCP) titanium from 200 to 1000 K.** Brooks, C.R. (Univ. of Tennessee, Knoxville). *International Journal of Thermophysics;* **2**: No. 4, 371-380(1981).

The heat capacity at constant pressure C/sub p/ of alpha (HCP) titanium from 200 to 1000 K has been analyzed for contributions from lattice vibrations and electron excitations. Experimental data in the literature have been used to obtain the heat capacity at constant volume C/sub v/ by the dilation correction. From C/sub v/ has been subtracted an harmonic lattice contribution C/sub VH/ given by the Debye heat capacity using a single Debye temperature and an electronic contribution C/sub VE/. The difference C/sub V/ - (C/sub VH/ + C/sub VE/) is positive, and from about 600 to

1000 K it is real in the sense that it is larger than the experimental uncertainty in C/sub V/. This difference is attributed to an anharmonic lattice vibration contribution C/sub VA/. Two models for C/sub VE/ have been used. One, which includes electron-phonon enhancement, leads to a C/sub VA/ of about 15% of C/sub V/ at 1000 K. The other takes into account the shift in the density of states with temperature and leads to a C/sub VA/ of about 5% of C/sub V/.

7135 **(RISLEY-Trans—4139) After-treatment of semi finished products and equipment made of austenitic steel to avoid stress corrosion.** Risch, K. Translated from *Chemie-Ingenieur-Technik ;* **51**: No. 5, 402-406(1979). 15p. NTIS (US Sales Only), PC A02. File Number DE84901951. DE84901951

Among the factors initiating stress corrosion, the extent and distribution of internal tensile stress are the least tractable. Unknown internal stresses are always superposed on the estimable operational stresses. If they arise from distortions or welding, the former are distributed throughout the entire cross section. The action of tools, e.g., on turning or grinding, can also lead to high internal stresses in a thin surface zone. Such stresses are of particular significance because stress corrosion is initiated on the surface. In this article, it is shown that it is usually sufficient to adequately reduce these surface-proximate internal tensile stresses, e.g., by a pickling process removing a surface layer of material, in order to eliminate stress corrosion and thus to extend the scope of austenitic steels. Should the internal tensile stresses due to distortion and welding suffice to initiate stress corrosion under particularly aggressive conditions, one can attempt to reduce the stress by suitable heat treatment; however, no impermissable change in the microstructure of the steel may occur. Finally, it is also possible to produce compressive stress in a thin surface zone by shot peening so that no stress corrosion can take place. The advantages and disadvantages of the various possibilities are illustrated with the aid of examples.

## 3602 Ceramics, Cermets, And Refractories

*REFER ALSO TO CITATION(S) 3602006283, 6653, 6920, 7053, 7128, 7286*

7136 **(AD-A—143207/9) Processing science to increase the reliability of ceramics. Final report 1 June 1983-31 May 1984.** Lange, F.F.; Green, D.J. (Rockwell International Corp., Thousand Oaks, CA (USA). Science Center). Jul 1984. 81p. NTIS, PC A05/MF A01.

Includes Report nos. TR-1 thru TR-4.

Contents: Sinterability of Zr02 and Al203 Powders the Role of Pore Coordination Number Distribution; Sinterability of Agglomerated Powders; Effect of Zr02 Inclusions on the Sinterability of Al203; and Relations Between Shrinkage Strain, Strain Rate and Rearrangement During Sintering: Experimental Observations with Al203, Zr02 and Al203/Zr02 Powder Compacts.

7137 **(CONF-8409117—4) Analytical electron microscopy of phase separated Ti/Mo cemented carbonitrides.** Heuer, A.H.; Sears, J.S.; Zaluzec, N.J.; Hamano, Y. (Case Western Reserve Univ., Cleveland, OH (USA); Argonne National Lab., IL (USA); Kyocera Ceramic Corp., Kyoto (Japan)). Oct 1984. Contract W-31-109-ENG-38. 3p. NTIS, PC A02. File Number DE85002767.

From 2. international conference on the science of hard materials; Rhodes, Greece (23 Sep 1984).

We have performed extensive TEM/STEM microstructural and microchemical analysis of several commercially available cemented carbonitrides, including quantitative EDS analysis to determine the Ti/Mo ratio and Ni, Co content of core and rim and the Ti and Mo content of the binder phase, semi-quantitative EELS analysis of the C/N ratio of core and rim, and detailed studies of the morphology and distribution of the binder pahse.

7138 **(DP—1689) Controlled $PuO_2$ particle size from Pu(III) oxalate precipitation.** Burney, G.A.; Smith, P.K. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Oct 1984. Contract AC09-76SR00001. 32p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85003441.

$PuO_2$ with reproducible particle size and morphology can be produced by controlling precipitation variables affecting the initial supersaturation and final solubility of plutonium oxalate. Such feed powders with constant characteristics are essential for reproducible fabrication response and controlled microstructures in the manufacture of $^{238}PuO_2$ heat sources. Calcination does not change the morphology or shape of the size distribution of the $PuO_2$ particles from that of the precipitated Pu(III) hydrated oxalate. For a given precipitation method, the size and morphology of the Pu(III) oxalate are determined by precipitation temperature, nitric acid concentration, plutonium concentration, and oxalate ion concentration. Functional relationships of these variables were developed to control and predetermine the size, extent of agglomeration, and dimensions of the $PuO_2$ particles over the range of these variables for $PuO_2$ production. This report describes statistically designed factorial experiments and characterization of $PuO_2$ by Coulter counter and scanning electron microscopy (SEM). These control factors were applied successfully in full-scale production.

7139 **(EGG-M—14884) Slit-ring test for evaluating fracture in tubular cross sections.** Landini, D.J.; Flinn, J.E.; Kelsey, P.V. Jr. (EG and G Idaho, Inc., Idaho Falls (USA)). 1984. Contract AC07-76ID01570. 22p. (CONF-841043—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003550.

From 37. Pacific Coast regional meeting of the American Ceramic Society; San Francisco, CA, USA (28 Oct 1984).

Slit-ring specimens were used to evaluate the fracture properties of several ceramic materials produced in tubular cross sections. The utility of the specimen and its applicability to heat exchanger components is discussed. Data obtained from tests using slit-ring specimens is presented and compared to data obtained using other test geometries.

7140 **(MLM—3192(OP)) Proton NMR and susceptibility measurements in TiCoH/sub x/.** Bowman, R.C. Jr.; Craft, B.D.; Tadlock, W.E.; Venturini, E.L.; Cantrell, J.S. (Monsanto Research Corp., Miamisburg, OH (USA). Mound; Sandia National Labs., Albuquerque, NM (USA); Miami Univ., Oxford, OH (USA). Dept. of Chemistry). 1984. Contract AC04-76DP00053. 15p. (CONF-841184—15). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003309.

From 30. annual conference on magnetism and magnetic materials; San Diego, CA, USA (27 Nov 1984).

The proton spin-lattice relaxation times ($T_1$) and magnetic susceptibilities (chi) are used to study the effects of hydrogen on the electronic structure properties of the intermetallic compound TiCo. Hydrogen addition systematically decreases both chi (T) and the proton $(T_1T)^-$/sup 1/2/ parameters, which are directly proportional to the local density of the Fermi level electronic states. The behavior for TiCoH/sub x/ is completely opposite to that previously found for several other Ti-based metal hydrides where these parameters tend to increase with hydrogen content. These differences are attributed to the Fermi levels falling on alternate sides of peaks in the densities of electronic states. The present results for TiCoH/sub x/ are compared with the magnetic properties and the theoretical band structures for the closely related hydride TiFeH/sub x/.

7141 **(MLM—3199) Calorimetric and x-ray diffraction study of the crystalline and amorphous titanium copper hydride systems.** Furlan, R.J. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 27 Nov 1984. Contract AC04-76DP00053. 35p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85004450.

Phase transition in the crystalline and amorphous Ti/sub y/CuH/sub x/ system, where $y = 1$ or 2 and $0 \leq x \leq 2.71$, were investigated using differential scanning calorimetry (DSC) at temperatures between 330K and 990K. Room temperature x-ray diffraction (XRD) measurements were made to identify the phases and

unit cell parameters before and after the DSC runs. The transition temperatures, kinetic activation energies, and heats of transition were found to be dependent upon the hydrogen concentration. While the trends in transition temperature and kinetic activation energy agree with one another, the heat of transition does not follow the same trends.

7142 **(MLM—3219(OP)) Effects of hydrogen on magnetic properties of amorphous zirconium alloys.** Venturini, E.L.; Bowman, R.C. Jr.; Cantrell, J.S. (Sandia National Labs., Albuquerque, NM (USA); Monsanto Research Corp., Miamisburg, OH (USA). Mound; Miami Univ., Oxford, OH (USA). Dept. of Chemistry). 1984. Contract AC04-76DP00053. 47p. (CONF-841184—16). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85003303.

From 30. annual conference on magnetism and magnetic materials; San Diego, CA, USA (27 Nov 1984).

The magnetic susceptibilities chi(T) of the amorphous ternary hydrides of the paramagnetic metallic glasses a-$Zr_2Pd$ and a-$Zr_3Rh$ have been measured between 7K and 300K. It has been found that chi(T) of both a-$Zr_2PdH$/sub x/ and a-$Zr_3RhH$/sub x/ decrease substantially with increasing hydrogen content. This behavior is primarily attributed to reductions in the densities of the Fermi level electronic states. Although chi(T) for crystalline $Zr_3Pd$ ($MoSi_2$ structure type) is smaller than the susceptibility of the a-$Zr_3Pd$ glass, chi(T) for a crystallized $Zr_3Rh$ sample was found to increase relative to the initial susceptibility for this glass.

7143 **(PB—84-220425) Toshiba review, volume 39, number 6, 1984.** (Toshibe Corp., Tokyo (Japan). Principal Office). 1984. 90p. (In Japanese). NTIS, PC E05/MF E01.

See also PB84-220433 through PB84-220490 and PB84-199199. Summaries in English. Color illustrations reproduced in black and white.

Special issue devoted to Fine Ceramics with reports on: Synthesis of Silicon Nitride Powder by Silica Reduction; Transformation-Toughened Zirconia Ceramics; High-Pressure Sintered CBN Compact Q-BONITE; Automatic Elastic Modulus Measuring System Using Ultrasonic Phase Comparison Method; Perception 120A Digital Electronic Private Branch Exchange for Domestic Market; High-Resolution Image Reproduction for CCD Imager Using Swing Action Mode; and information on patents and licenses.

7144 **Lattice gas with random-site energies and theory of novel amorphous metal hydride phase.** Richards, P.M. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Physical Review [Section] B: Condensed Matter;* **30**: No. 9, 5183-5189(1 Nov 1984).

A lattice gas with random-site energies is investigated as a model for hydrogen in amorphous metals. The author's recent theory for calculating the chemical potential in a system with many competing interactions is modified to include the random-site energies. Results are qualitatively different from those recently presented by Griessen using simple mean-field (MF) theory. Whereas MF theory predicts no phase separation above a critical value of the site energy width $\Delta$, the present model gives a finite critical temperature T/sub c/$\alpha 1/\Delta$ for large $\Delta$. It also predicts the critical concentration to decrease proportionally to $1/\Delta^2$ and yields a closed-loop, retrograde-solubility phase diagram. Thus, analogous to binary liquids with orientation-dependent interactions, there is a maximum concentration above which no phase separation occurs. For interactions and spread in site energy expected for Pd-based amorphous hydrides, the critical temperature is predicted to be approximately 200—250 K, which may be detectable by heat-capacity or spectroscopic techniques even if it is too low for pressure-versus-composition studies.

7145 **Sputtered films of superconducting $SmRh_4B_4$.** Zasadzinski, J.; Terris, B.D.; Gray, K.E.; Vaglio, R.; Hinks, D.G. (Materials Science and Technology Division, Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review [Section] B: Condensed Matter;* **30**: No. 9, 5095-5102(1 Nov 1984). Contract W-31-109-ENG-38.

Films of the coexistent antiferromagnetic superconductor $SmRh_4B_4$ have been made by sputtering. These films have been characterized by x-rays and superconducting critical temperatures T/sub c/, fields, and currents. Our best films have residual resistance ratios, r/sub R/, as high as or higher than for films of $ErRh_4B_4$ reported in the literature, and the highest T/sub c/ is 2.36 K. We find an anomalous dependence of T/sub c/ on r/sub R/, and offer two possible explanations (proximity-effect and disorder-enhanced spin-flip scattering), as well as propose a radiation-damage experiment to distinguish between these. The antiferromagnetic ordering temperature is shown to decrease with film disorder as does the ferromagnetic ordering temperature in radiation-damaged $ErRh_4B_4$. We find an approximately 1000-A-thick RhAl impurity phase at the sapphire-substrate/film interface which seems to result from a reaction with the substrate. The potential importance of RhAl and trace impurity phases on present measurements and planned tunneling experiments are discussed in detail. Finally, the full critical-field curves are presented along with an explanation of why the low-temperature values are independent of T/sub c/.

7146 **Crystal-field excitations in $CeB_6$ studied by Raman and neutron spectroscopy.** Zirngiebl, E.; Hillebrands, B.; Blumenroeder, S.; Guentherodt, G.; Loewenhaupt, M.; Carpenter, J.M.; Winzer, K.; Fisk, Z. (II. Physikalisches Institut, Universitat Koeln, 5000 Koeln 41, Federal Republic of Germany). *Physical Review [Section] B: Condensed Matter;* **30**: No. 7, 4052-4054(1 Oct 1984).

The $\Gamma_8$-$\Gamma_7$ crystalline-electric-field (CEF) transition of $CeB_6$ has been identified near 530 K (46 meV, 372 $cm^{-1}$) with use of inelastic neutron and polarized Raman scattering. From the anomalous temperature behavior of the transition energy observed in Raman scattering we deduce a $\Gamma_8$ ground state split by 20 $cm^{-1}$ (30 K). The novel CEF level scheme yields a consistent and unified interpretation of so far seemingly unrelated thermal, elastic, and magnetic data.

7147 **Ceramics for fusion devices.** Clinard, F.W. (Los Alamos National Lab., Los Alamos, NM). *Journal of Materials for Energy Systems;* **6**: No. 2, 100-106(Sep 1984).

Ceramics are required for a number of applications in fusion devices, among the most critical of which are magnetic coil insulators, windows for RF heating systems, and structural uses. Radiation effects dominate consideration of candidate materials, although good pre-irradiation properties are a requisite. Materials and components can be optimized by careful control of chemical and microstructural content, and application of brittle material design and testing techniques. Future directions for research and development should include further extension of the data base in the areas of electrical, structural, and thermal properties; establishment of a fission neutron/fusion neutron correlation including transmutation gas effects; and development of new materials tailored to meet the specific needs of fusion reactors.

7148 **Assessment of the thermodynamic values for (PuO/sub 1.5/) and high-temperature determination of the values of (PuC/sub 1.5/).** Besmann, T.M.; Lindemer, T.B. (Oak Ridge National Lab., TN). *Journal of the American Ceramic Society;* **66**: No. 11, 782-785(Nov 1983). Contract W-7405-ENG-26.

Thermodynamic values for (PuO/sub 1.5/) were assessed using an improved method for estimating $fef^\circ$ (PuO/sub 1.5/) and new data for $S_{298}^\circ$. Based on the assessment, a value of $\Delta H_{298}^\circ$ (PuO/sub 1.5/) = -828 kJ/mol is recommended. Measurements of (CO) pressure over the nominal equilibrium (PuC/sub 1.5/) + (PuO/sub 1.5/) + (C) were performed between 1348 and 1923 K, yielding pressures between 0.644 and 11,600 Pa. Second- and third-law analyses were used to obtain a value for $\Delta H_{298}^\circ$ (PuC/sub 1.5/) = -93.3 +/- 3.3 kJ/mol.

7149 **Beta SiC powders produced by carbothermic reduction of silica in a high-temperature rotary furnace.** Wei, G.C.T. (Oak Ridge National Lab., TN). *Journal of the American Ceramic Society;* **66**: No. 7, C111-C113(Jul 1983). (CONF-8210286—). Contract W-7405-ENG-26.

From 35. American Ceramic Society annual Pacific Coast Regional meeting; Seattle, WA, USA (27 Oct 1982).

Sinterable $\beta$-SiC powders were synthesized by carbothermic reduction of silica with carbon in a high-temperature rotary furnace. The powders were characterized as to sinterability, surface area, particle size, and morphology.

7150 **Slow crack growth behavior in transformation-toughened $Al_2O_3$-$ZrO_2(Y_2O_3)$ ceramics.** Becher, P.F. (Oak Ridge National Lab., TN). *Journal of the American Ceramic Society;* 66: No. 7, 485-488(Jul 1983). Contract W-7405-ENG-26.

Significant increases in the critical fracture toughness (K/sub IC/) over that of alumina are obtained by the stress-induced phase transformation in partially stabilized $ZrO_2$ particles which are dispersed in alumina. More importantly, improved slow crack growth resistance is observed in the alumina ceramics containing partially stabilized $ZrO_2$ particles when the stress-induced phase transformation occurs. Thus, increasing the contribution of the $ZrO_2$ phase transformation by tailoring the $Y_2O_3$ stabilizer content not only increases the critical fracture toughness (K/sub IC/) but also the K/sub Ia/ to initiate slow crack growth. For example, crack velocities ($n\mu$) $\geqq 10^{-9}$ m/s are obtained only at K/sub Ia/ $\geqq$ 5 MPa.m/sup 1/2/ in transformation-toughened (K/sub IC/ = 8.5 MPa.m/sup 1/2/) composites vs K/sub Ia/ $\geqq$ 2.7 MPa.m/sup 1/2/ for comparable velocities in composites where the transformation does not occur (K/sub IC/ = 4.5 MPa.m/sub 1/2/). This behavior is a result of crack-tip shielding by the dissipation of strain energy in the transformation zone surrounding the crack. The stress corrosion parameter n is lower and A greater in these fine-grained composite materials than in fine-grained aluminas. This is a result of the residual tensile stresses associated with larger ($\geqq$ 1 $\mu$m) monoclinic $ZrO_2$ particles which reside along the intergranual crack path.

7151 **Current understanding of stable and metastable phase equilibria and reactions in the $SiO_2$-$\alpha$-$Al_2O_3$ system.** Pask, J.A. (Lawrence Berkeley Lab., CA). pp 21-31 of Ceramic powders. Vincenzini, P. (ed.). Amsterdam, Netherlands; Elsevier Scientific Publishing Company (1983). Contract W-7405-ENG-48.

Procedures in the preparation of specimens in this system are critical due to difficult nucleation kinetics of $\alpha$-$Al_2O_3$ when the silicate liquid is unsaturated with $Al_2O_3$ molecules even though it is supersaturated relative to $\alpha$-$Al_2O_3$, and the capability of mullite growing from an alumino-silicate melt during cooling to accommodate larger amounts of $Al_2O_3$. As a result, misinterpretations of experimental data have occurred in published reports. Stable and metastable phase equilibrium diagrams in the $\alpha Al_2O_3$-$SiO_2$ system are presented.

7152 **Pre-eutectic densification in $MgF_2$-$CaF_2$.** Hu, S.C.; De Jonghe, L.C. (Lawrence Berkeley Lab., CA). pp 719-728 of Ceramic powders. Vincenzini, P. (ed.). Amsterdam, Netherlands; Elsevier Scientific Publishing Company (1983). Contract AC03-76SF00098.

Increased densification rates were found as much as 200°C below the eutectic temperature (980°C) for $MgF_2$ containing small amounts of $CaF_2$. Constant heating rate and constant temperature sintering data, as well as microstructural developments indicated that solid state grainboundary transport rates had been enhanced by the eutectic forming additive. The effect saturated at about 1 wt% $CaF_2$. The results suggest that densification of ceramic powders could be favorably affected without a substantial increase in the grain growth rate, by the addition of small amounts of eutectic forming additives, and sintering below the eutectic temperature.

7153 **Stabilities, stoichiometries and site occupancies in hydrides of intermetallic compounds.** Westlake, D.G. (Argonne National Lab., IL). pp 85-96 of Electronic structure and properties of hydrogen in metals. Jena, P.; Satterthwaite, C.B. New York, NY, USA; Plenum Publishing Corporation (1983).

In the literature, one can find numerous attempts to explain the observed stabilities, stoichiometries and site occupancies in hydrides of the various families of intermetallic compounds. Some of the approaches to these problems are critically reviewed here. For some, but not all such hydrides, the stabilities have been shown by different researchers to correlate with the enthalpy for formation of the intermetallic compound, itself, or with cell size, or electronic properties, or elastic properties. It appears, therefore, that all of these effects may play a role, but none is dominant in all cases. The development of the procedure for qualitative and quantitative determinations of H-site occupancy from calculations of enthalpies for the formation of imaginary binary hydrides was reviewed. Such inspection raises the question of possible fortuitous agreement between experimental observations and predictions arising from the technique. The concepts of minimum hole size for H occupation and minimum H-H distance in stable hydrides of metals or intermetallic compounds have been discussed in terms of their importance to preferred H sites and to stoichiometry, and considerations necessary to a geometric model have been outlined. The model is used to rationalize observed H sites and stoichiometry of $LaNi_5H$/sub x/. The review points up the need for theoretical treatment leading to fundamental understanding of such systems.

## 3603 Composite Materials

7154 **(ORNL/TM—9235) Fabrication of fiber-reinforced ceramic composites by chemical vapor infiltration.** Caputo, A.J.; Lackey, W.J. (Oak Ridge National Lab., TN (USA)). Oct 1984. Contract AC05-84OR21400. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85003809.

Ceramic fiber-ceramic matrix composites are of interest because of their potentially higher strength and toughness. A vacuum forming technique was used to fabricate low-density structures from SiC fibers. These fibrous structures were then infiltrated by chemical vapor deposition. Matrices of $Si_3N_4$ and SiC have been deposited.

7155 **(UCRL—90195) Mechanics of composite materials.** Christensen, R.M. (Lawrence Livermore National Lab., CA (USA)). 9 Jan 1984. Contract W-7405-ENG-48. 14p. (CONF-840459—6). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003611.

From 29. national SAMPE symposium; Reno, NV, USA (3 Apr 1984).

An assessment is given of the means of predicting the mechanical properties of composite materials in terms of the microstructure properties. Fiber reinforced composites are considered as well as other types of heterogeneous combinations of materials. Various geometric models of microstructure characteristics are discussed. Primary emphasis is given to elasticity results.

7156 **Delayed cure bismaleimide resins.** Adams, J.E.; Jamieson, D.R. (to Dept. of Energy). US Patent 4,464,520. 7 Aug 1984. Filed date 12 Aug 1982. vp.

PAT-APPL-407664.

Polybismaleimides prepared by delayed curing of bisimides having a formula 1-$R_1$,2-$R_2$,4-(2,5-DI(O=)-3-Pyrrolin-3-YL),4-((2,5-DI(O=)-3-Pyrrolin-3-YL)-(4-$R_1$,5-$R_2$-1,2Phenylene)-X-($CH_2$)N-X-)Benzene wherein $R_1$ and $R_2$ each independently is H,$C_1$⁻₄-alkyl, $C_1$⁻₄-alkoxy, Cl or Br, or $R_1$ and $R_2$ together form a fused 6-membered hydrocarbon aromatic ring, with the proviso that $R_1$ and $R_2$ are not t-butyl or t-butoxy; X is O, S or Se; n is 1-3; and the-($CH_2$) /SUB n/ -group, optionally, is substituted by 1-3 methyl groups or by fluorine.

## 3604 Polymers And Plastics

*REFER ALSO TO CITATION(S) 3604006406*

7157 **(DOE/ER/10912—T2) [Elastomeric materials]. Final technical report, June 15, 1981-June 14, 1984.** Eichinger, B.E. (Washington Univ., Seattle (USA). Dept. of Chemistry). 1984. Contract AT06-81ER10912. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85002851.

The progress report submitted one year ago reviewed work on random networks, polymeric chelates, and differential sorption. Within the past year our group has continued its research in these areas and has added two major new thrusts into the study of the critical phenomenon of gelation and the theory of the shape distribution of macromolecules.

**7158 Method of forming metallic coatings on polymeric substrates.** Liepins, R. (to Dept. of Energy). US Patent 4,464,416. 7 Aug 1984. Filed date 16 Feb 1983. vp.

PAT-APPL-467104.

Very smooth polymeric coatings or films graded in atomic number and density can readily be formed by first preparing the coating or film from the desired monomeric material and then contacting it with a fluid containing a metal or a mixture of metals for a time sufficient for such metal or metals to sorb and diffuse into the coating or film. Metal resinate solutions are particularly advantageous for this purpose. A metallic coating can in turn be produced on the metal-loaded film or coating by exposing it to a low pressure plasma of air, oxygen, or nitrous oxide. The process permits a metallic coating to be formed on a heat sensitive substrate without the use of elevated temperatures.

## 3606 Other Materials

*REFER ALSO TO CITATION(S) 3606006305, 6495, 6514, 6571, 6577, 6580, 6584, 6697, 7082, 7098, 7296, 7353, 7585, 7591*

**7159 (CONF-850110—1) Study of magnetism at surfaces by scattering of neutrons at grazing incidence.** Felcher, G.P. (Argonne National Lab., IL (USA)). Jul 1984. Contract W-31-109-ENG-38. 3p. NTIS, PC A02/MF A01; GPO Dep. File Number DE84015850.

From International conference on neutron scattering in the '90s; Juelich, F.R. Germany (14 Jan 1985).

Neutrons can provide information on magnetic phenomena at surfaces. The simplest experiment involves the measurement of the reflectivity of a well-collimated beam from the surface, as a function either of the neutron wavelength or of the angle of incidence theta/sub i/. Using polarized neutrons, the spin-dependent reflectivity of a magnetically-active material can determine the depth profile of the magnetic induction B. A prototype instrument at the Intense Pulsed Neutron Source at Argonne has already demonstrated the feasibility of this technique in determining the penetration depth of an external magnetic field in superconductors. Further experiments are being planned to study the magnetic disturbances close to the surface of ferromagnets; a first experiment on films of iron oxides showed a remarkable change of the magnetic depth profile with increasing oxidation.

**7160 (DOE/ER/10936—T1) Structure and phonons in potassium mercurographitides.** Kamitakahara, W.A.; Eklund, P.C.; Delong, L.E.; Yang, M.H. (Ames Lab., IA (USA); Kentucky Univ., Lexington (USA). Dept. of Physics and Astronomy). 1984. Contract AS05-81ER10936;W-7405-ENG-82. 3p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85004329.

Neutron scattering methods were applied to study the intercalant ordering and the lattice dynamics of the superconducting graphite intercalation compounds $KHgC_4$ and $KHgC_8$. Two coexisting phases with different intercalant ordering schemes were found for $KHgC_4$. In $KHgC_8$, only one phase was observed, with only two-dimensional ordering of the intercalant.

**7161 (DOE/ER/10936—T2) Anomalous pressure dependences of the superconducting transition temperature of graphite intercalation compounds.** DeLong, L.E.; Yeh, V.; Tondiglia, V.; Eklund, P.C.; Lambert, S.E.; Maple, M.B. (Kentucky Univ., Lexington (USA). Dept. of Physics and Astronomy; California Univ., San Diego, La Jolla (USA). Dept. of Physics). 1983. Contract AS05-81ER10936;AT03-76ER70227. 3p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004353.

Superconducting graphite intercalation compounds (GIC) exhibit a number of interesting properties such as a high anisotropy of the upper critical magnetic field H/sub c2/ and irreproducible values of the superconducting critical temperature T/sub c/ as measured for different samples of a given compound. Further, the observations of large c-axis compressibilities and a number of temperature- and pressure-induced phase transitions in GIC's imply that their T/sub c/'s may be highly pressure sensitive, and have motivated the present experiments.

**7162 (DOE/ER/10936—T3) High pressure superconducting behavior of the stage-1 alkali metal-graphite intercalation compounds $RbC_8$ and $CsC_8$.** Lambert, S.E.; Chen, J.W.; Maple, M.B.; DeLong, L.E.; Yeh, V.; Tondiglia, V.; Eklund, P.C. (California Univ., San Diego, La Jolla (USA). Dept. of Physics; Kentucky Univ., Lexington (USA). Dept. of Physics and Astronomy). 1983. Contract AS05-81ER10936;AT03-76ER70227. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004352.

We have performed measurements of the pressure dependence of the superconducting transition temperature T/sub c/ of the stage-1 graphite intercalation compounds $RbC_8$ and $CsC_8$ as a function of hydrostatic pressure $P \leq 2.2$ GPa. $RbC_8$ is nonsuperconducting to temperatures $T \geq 0.07°K$ at $P = 0$ and to $T \geq 1.3°K$ for $P \leq 2.2$ GPa. However, T/sub c/'s $\geq 0.25°K$ were detected at $P < 0.09$ GPa. A superconducting transition was also found for $CsC_8$ at $P = 0$ with an onset temperature $T_0 \simeq 0.09°K$. Our high pressure results suggest that pressure-induced phase transitions may be present in $RbC_8$ at $P < 0.09$ GPa and in $CsC_8$ at $P > 0.8$ GPa.

**7163 (LBL—18554) Impurity complexes in pure elemental semiconductors.** McMurray, R.E. Jr. (Lawrence Berkeley Lab., CA (USA)). Oct 1984. Contract AC03-76SF00098. 186p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE85003473.

The physics of shallow impurity levels in semiconductors in many ways corresponds to the physics of simple isolated atoms in free space. Despite the dielectric screening of the lattice and the necessity of using an effective mass rather than the free electron mass, such questions as the energy spectrum and selection rules for dipole-allowed single photon transitions can be treated rather simply for elemental impurities. However, additional complications arise due to internal structure when an electrically active impurity complex is considered. The theoretical and experimental implications of the multi-atom complex form the basis of this thesis. Although several impurity complexes in germanium had been previously explained in the context of a tunnelling-hydrogen model, additional understanding was needed. Also, several impurity complex centers had still remained unexplained, and three of these in particular, those due to carbon-nitrogen centers, make up a prominent portion of the research for this thesis. In addition to providing a satisfactory model to explain all of the known experimental facts which were discovered in this work regarding these carbon-nitrogen impurity complexes, this dissertation brings together many of the properties of other impurity complexes in a way in which they can be understood as an overall system of complexes, rather than as isolated cases. Such is the situation for the group II impurity-hydrogen complexes, and for the overcharged acceptors of the groups I and II impurities. Overall, this work brings together the existing knowledge of electrically-active shallow impurity complex centers in elemental semiconductors.

**7164 (SAND—84-1271C) Si-on-Insulator formation using a line-source electron beam.** Knapp, J.A. (Sandia National Labs., Albuquerque, NM (USA)). 1984. Contract AC04-76DP00789. 4p. (CONF-841157—20). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003449.

From Symposium on the scientific basis for nuclear waste management; Boston, MA, USA (26 Nov 1984).

A line-source electron beam has been used to melt and recrystallize isolated Si layers to form Si-on-Insulator structures, and the process is simulated by heat flow calculations. Using sample sweep speeds of 100 to 600 cm/s and peak power densities up to 75 $kW/cm^2$ in the 1 x 20 mm beam, we have obtained single-crystal areas as large as 50 x 350 $\mu$m. Seed openings to the substrate are used to control the orientation of the regrowth and the heat flow in the recrystallizing film. A finite-element heat flow code has been developed which correctly simulates the experimental results and which allows the calculation of untried sample configurations.

**7165 Spin-correlated crystal field parameters for lanthanide ions substituted into $LaCl_3$.** Crosswhite, H.M.; Newman, D.J. (Chemistry Division, Argonne National Laboratory Argonne, Illinois 60439). *Journal of Chemical Physics;* **81**: No. 11, 4959-4962(1 Dec 1984). Contract W-31-109-ENG-38.

Fits to spectral energy levels for $Ho^{3+}$:$LaCl_3$ and $Gd^{3+}$:$LaCl_3$ establish, for the first time, empirical values of the lanthanide spin-correlated crystal field parameters. The fitted rank 6 parameters are consistent with the superposition model analysis and provide the solution to a long standing problem in the fitted values of the crystal field parameters for trivalent lanthanide ions in $LaCl_3$.

**7166 Nonlocal-density-functional approximation for exchange and correlation in semiconductors.** Hybertsen, M.S.; Louie, S.G. (Department of Physics, University of California, Berkeley, California 94720 and Lawrence Berkeley Laboratory, Berkeley, California 94720). *Physical Review [Section] B: Condensed Matter;* **30**: No. 10, 5777-5790(15 Nov 1984).

Using the weighted density approximation for the exchange-correlation energy, the band-structure and bulk structural properties of the prototypical semiconductors Si and Ge have been systematically studied. The weighted density approximation is based on an improved description of the exchange-correlation hole that explicitly accounts for the inhomogeneous charge density found in real materials. We find that the approximation as proposed is inadequate for the case of semiconductors where charge inhomogeneity is intimately connected to a gap in the excitation spectrum with consequent qualitative changes in screening. We use a simple extension of the weighted density approximation which takes account of semiconductor screening. With this functional, we find substantial improvement in the calculated minimum gap over the results of the usual local-density approximation as compared to experiment. However, the direct gaps are not significantly improved. Calculated structural properties are, moreover, found to be in excellent agreement with experiment. By way of contrast, the weighted density approximation implemented with metallic screening gives a smaller change in the band structure and more importantly, substantially poorer calculated structural properties. A discussion of the qualitative differences between the weighted density approximation and the usual local-density approximation for covalently bonded semiconductors is presented.

**7167 Comparison between the electronic structures of GaAs(111) and GaAs (1 1 1) from angle-resolved photoemission.** Bringans, R.D.; Bachrach, R.Z. (Xerox Palo Alto Research Center, Palo Alto, California 94303). *Physical Review Letters;* **53**: No. 20, 1954-1957(12 Nov 1984).

Angle-resolved photoemission spectra have been measured for the polar (1 1 1) and (111) surfaces of GaAs. The results show definitively that although both faces exhibit a (2 x 2) reconstruction, the local geometries of the unit cells must be distinctly different.

**7168 Structural and electronic properties of the high-pressure hexagonal phases of Si.** Chang, K.J.; Cohen, M.L. (Department of Physics, University of California and Materials and Molecular Research Division, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Physical Review [Section] B: Condensed Matter;* **30**: No. 9, 5376-5378(1 Nov 1984). Contract AC03-76SF00098.

The pseudopotential method is used to examine the structural transitions of Si from $\beta$-Sn to simple hexagonal to hexagonal close packed. The calculated transition pressures, transition volumes, and c/a ratios are in good agreement with the measured values. For the simple hexagonal phase, a soft-phonon mode and a high density of states at the Fermi level are found. These properties and the strong covalent interlayer bonding suggest the existence of superconductivity in this system. Investigation of the band structure reveals parallel bands separated by about 3 eV along the LH axis of the Brillouin zone; these are the likely origin of the main peak in the optical spectrum.

**7169 Energy spectra of ion-induced Auger electrons under channeling conditions.** Kudo, H.; Schneider, D.; Kanter, E.P.; Arcuni, P.W.; Johnson, E.A. (Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review [Section] B: Condensed Matter;* **30**: No. 9, 4899-4904(1 Nov 1984). Contract W-31-109-ENG-38.

We have measured the secondary-electron energy spectra resulting from 3.0- and 3.5-MeV $H^+$ bombardment of a single-crystal silicon target under Si<110> channeling and nonchanneling conditions. The energy degradation of Si K-shell Auger electrons observed in the secondary-electron spectra has been successfully interpreted by a theoretical model based on the ion-beam shadowing effect and on the Poisson distribution of the inelastic scattering suffered by the electrons. The relationship between the mean free path for inelastic scattering and the mean energy of excitations produced by 1.6-keV electrons in the Si crystal was obtained from a comparison between the measured and calculated energy spectra of the energy-degraded Si K-shell Auger electrons. This relationship gives a mean excitation energy of 44.2 +- 3.5 eV when the mean free path for inelastic scattering is assumed to be $\lambda = 32$ A, as given by theory.

**7170 Phase transition in fluid nitrogen at high densities and temperatures.** Nellis, W.J.; Holmes, N.C.; Mitchell, A.C.; van Thiel, M. (University of California Lawrence Livermore National Laboratory, Livermore, California 94550). *Physical Review Letters;* **53**: No. 17, 1661-1664(22 Oct 1984). Contract W-7405-ENG-48.

Dynamic equation-of-state data are presented for liquid $N_2$ single- and double-shocked to pressures of 100 GPa (1 Mbar), compressions to fourfold over initial liquid density, and internal energies to 1 MJ/mole. Three double-shock points lie above the principal Hugoniot in pressure-volume space, the first such observation in condensed matter. The data are interpreted in terms of a continuous phase transition, identified as molecular dissociation by comparison of the shock compression curves of liquid $N_2$ and isoelectronic CO.

**7171 Nucleation, growth, and scaling in a pressure-induced first-order phase transformation RbI.** Yamada, Y.; Hamaya, N.; Axe, J.D.; Shapiro, S.M. (Faculty of Engineering Science, Osaka University, Toyonaka, Osaka 560, Japan). *Physical Review Letters;* **53**: No. 17, 1665-1668(22 Oct 1984). Contract AC02-76CH00016.

We have investigated the kinetics of the NaCl-to-CsCl phase transformation in RbI at room temperature (P/sub c/roughly-equal3.5 kbar) by monitoring the time-dependent changes in neutron powder diffraction peaks. Above P/sub c/ the rate of growth of the stable phase increases with increasing pressure, but the growth curves display a universal shape, consistent with the Kolmogorov model of nucleation and growth, when plotted versus a scaled time parameter, tau = t/tau$_0$(P).

**7172 Tracer diffusion and electrical conductivity in sodium-cesium silicate glasses.** Jain, H.; Peterson, N.L.; Downing, H.L. (Argonne National Lab. IL). *Journal of Non-Crystalline Solids;* **55**: 283-300(1983).

The tracer diffusion coefficients of $^{22}Na$ and $^{137}Cs$, and the electrical conductivity have been measured in the $(Na, Cs)_2O{:}3SiO_2$ glasses as a function of temperature and Cs/Na ratio. Complex impedance analysis was used for the conductivity measurements. The Haven ratio at 396.5°C increases from 0.3 to 0.4 in single-alkali glasses to 0.8 for the mixed-alkali compositions. The results are explained in terms of a single-jump mechanism; interactions between alkali ions and non-bridging oxygen ions, and between different alkali ions, produce the observed correlation effects.

# 40 CHEMISTRY

## 4001 Analytical And Separations Chemistry

*REFER ALSO TO CITATION(S) 4001006295, 6296, 6297, 6326, 6424, 6425, 6426, 6427, 6450, 6450, 6451, 6523, 6526, 6526, 6536, 6543, 7213, 7216, 7220, 7355, 7405, 7410*

7173 **(BNL—35338) Synchrotron x-ray fluorescence and extended x-ray absorption fine structure analysis.** Chen, J.R.; Gordon, B.M.; Hanson, A.L.; Jones, K.W.; Kraner, H.W.; Chao, E.C.T.; Minkin, J.A. (State Univ. of New York, Geneseo (USA); Brookhaven National Lab., Upton, NY (USA); Geological Survey, Reston, VA (USA)). 1984. Contract AC02-76CH00016. 22p. (CONF-8404131—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003606.

From Scanning electron microscopy conference; Philadelphia, PA, USA (15 Apr 1984).

The advent of dedicated synchrotron radiation sources has led to a significant increase in activity in many areas of science dealing with the interaction of x-rays with matter. Synchrotron radiation provides intense, linearly polarized, naturally collimated, continuously tunable photon beams, which are used to determine not only the elemental composition of a complex, polyatomic, dilute material but also the chemical form of the elements with improved accuracy. Examples of the application of synchrotron radiation include experiments in synchrotron x-ray fluorescence (SXRF) analysis and extended x-ray absorption fine structure (EXAFS) analysis. New synchrotron radiation x-ray microprobes for elemental analysis in the parts per billion range are under construction at several laboratories. 76 references, 24 figures.

7174 **(DOE/ER/10859—3) Interfacial chemistry in solvent extraction systems. Progress report, March 1, 1983-February 28, 1985.** Neuman, R.D. (Minnesota Univ., St. Paul (USA). Dept. of Forest Products). Oct 1984. Contract AC02-81ER10859. 43p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85003313.

The interfacial tension, metal distribution equilibria, and extraction kinetics of the system HDEHP/n-hexane/$CaCl_2$ solution were investigated. The interfacial activity behavior suggests that reversed micelles begin to form above a critical HDEHP concentration. Electron microscopic techniques have confirmed the existence of a first-order phase transition occurring in close-packed monolayers. Electron microscopic experiments examining aggregate formation in HDEHP and stearic acid monomolecular films spread on $Ca^{2+}$-containing subsolutions were also performed. A desorption study of model extractants to test a desorption model on the intermolecular interactions in interfacial films was recently completed. A Lewis-type mass transfer cell was constructed to investigate the extraction kinetics of $Ca^{2+}$ by HDEHP in n-hexane using liquid scintillation counting techniques. A definite correlation between interfacial tension and mass transfer was observed. Below the critical HDEHP concentration, the mass transfer is negligible and the extracted species in the organic phase is $Ca(DEHP)_2 \cdot 2(HDEHP)$. The rate of extraction is very slow. On the other hand, if extraction is performed under conditions where reversed micelles form, both the percent calcium extracted and the mass transfer coefficient suddenly become very significant. Talc tracer experiments suggest interfacial turbulence occurs under the same conditions that promote the formation of reversed micelles.

7175 **(GJ/TMC—19) Laboratory intercomparison of analytical results on samples contaminated by uranium mill tailings.** Korte, N.; Hollenbach, M.; Donivan, S. (Bendix Field Engineering Corp., Grand Junction, CO (USA)). Oct 1984. Contract AC07-76GJ01664. 115p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE85002529.

This laboratory intercomparison study was conducted to assess the adequacy of state-of-the-art techniques used to analyze water and soil samples collected at DOE remedial action sites. Resources available for the study were directed toward quickly obtaining the maximum amount of pertinent data without performing an extensive statistical analysis. Hence, the methods evaluated are primarily applicable to analysis of samples contaminated with uranium mill tailings, since samples of that type were readily available. The water samples were analyzed for radium-226, uranium, molybdenum, arsenic, selenium, vanadium, sulfate, and gross alpha activity. The soil samples were analyzed for radium-226, uranium, molybdenum, arsenic, selenium, and vanadium. The analytical methods and calibration techniques used are discussed in this report, as are the results of the intercomparison study. Information presented herein should be helpful in the selection of a support laboratory and in planning for and ensuring reliable laboratory analyses. 14 references, 2 figures, 2 tables.

7176 **(GKSS—83/E/76) Application of radioactivity standards for the instrumental neutron activation analysis.** Niedergesaess, R.; Schnier, C. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.)). [nd]. 5p. (In German). NTIS (US Sales Only), PC A02/MF A01. File Number DE84752327.

The method for neutron activation analysis is a well-known technique for trace amount elemental analysis. At GKSS mainly the special technique of instrumental neutron activation is used as an absolute method. For this purpose gamma radiation measuring systems with high resolution are necessary, with the main components such as germanium detector, amplifier and multichannel-analyser. These systems have to be calibrated on an absolute scale by gamma radiation standards. The precise calibration of these devices is repeated every year, the detection probability is checked for each series of mesurements in time intervals of about one weak, and the energy is calibrated for each individual measurement.

7177 (INIS-mf—9098, pp 9-10) **Progress in instrumental analysis: developments in atomic-absorption, x-ray-fluorescence, and plasma-emission spectrometry for the analysis of metals and ores.** Watters, R.L. Jr. (Center for Analytical Chemistry, National Bureau of Standards). 1984. NTIS (US Sales Only), PC A08/MF A01. File Number TI85780156. (CONF-8403156—Absts.).

From MINTEK 50: international conference on recent advances in mineral science and technology; Sandton, South Africa (26 Mar 1984).

7178 (INIS-mf—9098, pp 149-150) **Application of x-ray fluorescence spectrometry in minerals processing.** Willis, J.P. (Cape Town Univ. (South Africa)). 1984. NTIS (US Sales Only), PC A08/MF A01. File Number TI85780156. (CONF-8403156—Absts.).

From MINTEK 50: international conference on recent advances in mineral science and technology; Sandton, South Africa (26 Mar 1984).

7179 (INIS-mf—9098, pp 145-146) **Modern trends in x-ray powder diffraction.** Snyder, R.L. (Alfred University, U.S.A.); Goebel, H.E.; Hubert, G. (Siemens AG, West Germany). 1984. NTIS (US Sales Only), PC A08/MF A01. File Number TI85780156. (CONF-8403156—Absts.).

From MINTEK 50: international conference on recent advances in mineral science and technology; Sandton, South Africa (26 Mar 1984).

7180 (INIS-mf—9098, pp 79-80) **Laboratory testing of uludag scheelite concentrate for the production of ammonium paratungstate.** Topkaya, Y.A.; Eric, H. (Middle East Technical Univ., Ankara (Turkey)). 1984. NTIS (US Sales Only), PC A08/MF A01. File Number TI85780156. (CONF-8403156—Absts.).

From MINTEK 50: international conference on recent advances in mineral science and technology; Sandton, South Africa (26 Mar 1984).

7181 **(ORNL/TM—9290) Development report: radiac system for measuring aqueous tritium concentration by the liquid scintillation method.** Colman, G.A.; Allin, G.W.; De Lorenzo, J.T.; Phelps, J.E. (Oak Ridge National Lab., TN (USA)). Oct 1984. Contract AC05-84OR21400. 92p. NTIS, PC A05/MF A01; GPO Dep. File Number DE85003799.

This report describes the design, assembly, and testing of a room temperature bench-scale liquid scintillation system for aque-

ous tritium measurement. With this system, urine or water samples with tritium concentrations of 1 to 5 μCi/L can be measured with 20% uncertainty in a typical counting time of 40 s to 3 min, depending on the background count rate, activity level, and degree of quench. Concentrations above 5 μCi/L can be measured within 10% uncertainty in a typical counting time of less than 3 min. In water samples, tritium concentrations as low as 0.1 μCi/L can be measured within 20% uncertainty in a typical counting time of 30 min, and within 30% uncertainty in less than 10 min. The minimum measurable activity can be changed from 1 μCi/L to as little as 0.1 μCi/L by a simple change in the operating program. The microprocessor collects, processes, and transmits data and also interacts with the operator, which minimizes the workload and thereby reduces the chance of operator-induced error. Very little training is required: the operator simply follows basic instructions on the display. A photomultiplier tube balance circuit maximizes counting efficiency and also eliminates the need for stocking matched pairs of photomultiplier tubes. The use of a fast coincidence gate eliminates the need for refrigerating the scintillator or storing it in the dark. The design of the system also allows the degree of quench for a particular sample to be determined without the use of a radioactive gamma source.

7182 **(PNL-SA—12032) Separation of gas mixtures with coordination complexes.** Nelson, D.A.; Hallen, R.T.; Lilga, M.A.; Lee, C.L.; Janes, B.R. (Pacific Northwest Lab., Richland, WA (USA)). Feb 1984. Contract AC06-76RL01830. 13p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85000363.

Several coordination complexes were examined for their ability to sorb $CO_2$, CO, or $H_2$ reversibly. Three of those complexes appeared worthy of further investigation. Carbon dioxide was rapidly bound by crystalline $Ir(dmpe)_2Cl$ within 10 seconds. Desorption of $CO_2$ was achieved with heat and decreased pressure. The series $Pd_2(dpm)_2X_2$, where X = Cl, Br, I, and NCO, was found to be of considerable interest for CO sorption. Sorption of CO was rapid and the kinetics appeared to be quite favorable. The kinetics were not influenced by the presence of $CO_2$, $N_2$, $O_2$, $H_2$, ethylene or acetylene. Thus, $Pd_2(dpm)_2X_2$ showed considerable specificity for CO. Hydrogen, oxygen, and carbon monoxide were sorbed by $Ru(CO)_2(PPh_3)_3$; however, the complex required that a phosphine ligand be released prior to gas coordination. The kinetics of these reactions indicated that $H_2$ was bound twice as fast as CO and seven times faster than $O_2$.

7183 **(SAND—84-1422) Analytical electron microscopy: a potential new tool in the study of materials compatibility.** Romig, A.D. Jr. (Sandia National Labs., Albuquerque, NM (USA)). Oct 1984. Contract AC04-76DP00789. 39p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85003271.

The analytical electron microscope (AEM) is proving to be a powerful tool for the study and characterization of engineering materials including metals, ceramics and polymers. The power of this technique lies in its ability to examine materials at high spatial resolution. High resolution characterization is possible via several techniques including high resolution imaging in which features less than 1 nm can be resolved, high resolution compositional analysis by x-ray energy dispersive spectrometry and electron energy loss spectrometry in which chemical compositions can be determined from volumes less than 50 nm in diameter, and high resolution convergent beam microdiffraction in which the crystallographic nature of small volumes, less than 50 nm in diameter, of the material can be determined. With these techniques it is possible to characterize reactions within materials and between materials at a spatial scale unattainable by other analytical techniques. The basic principles of AEM are described and several examples of applications to materials discussed. Specific examples include characterization of uranium alloys, analysis of hot-cracking failures in austenitic stainless steel weldment heat affected zones, and diffusion in refractory metal alloys.

7184 **(UCRL—91723) Nondestructive assay instrumentation for a Savannah River Plant upgrade project.** Camp, D.; Eckels, D.; Gunnink, R.; Prindle, A.; Ruhter, W. (Lawrence Livermore National Lab., CA (USA)). 25 Oct 1984. Contract W-7405-ENG-48. 9p. (CONF-841007—30). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003225.

From Nuclear science symposium; Orlando, FL, USA (31 Oct 1984).

We have designed and are developing three different computer-based spectrometer systems. Two will measure the concentration of Pu solutions by gamma-ray and by stimulated x-ray fluorescence emissions of solid samples in closed containers. All systems are coupled to remote terminals and bar code readers, and also to mini-computer based multichannel analyzers, which in turn are linked to another computer to provide a state-of-the-art nondestructive assay capability. Installation at the Savannah River Plant is planned in late 1985. 7 references.

7185 **Negative ion production with the electrospray ion source.** Yamashita, M.; Fenn, J.B. (Yale Univ., New Haven, CT). *Journal of Physical Chemistry;* **88**: No. 20, 4671-4675(27 Sep 1984).

Solution passed through a small capillary tube at several kilovolts relative to its surroundings is electrosprayed into a bath gas at slightly above atmospheric pressure to form a dispersion of ions that expands into vacuum through a small sonic orifice. A portion of the resulting supersonic free jet passes through a skimmer carrying ions into a quadrupole mass spectrometer. Previously reported results were obtained with positive ions formed when the capillary was at a positive potential. The present report concerns operation with the capillary at a negative potential to produce negative ions. As in the case of operation in the positive mode ions with varying degrees of solvation can be obtained from a variety of solute species including complex and nonvolatile organic molecules. No fragmentation of parent species is observed as long as electrical discharge is avoided in the gas phase. The presence of electron scavengers in the bath gas raises the potential at which discharge phenomena begin. Differences and similarities relative to operation in the positive mode are discussed.

7186 **Spatially resolved vibrational temperature profiles in flames from molecular absorption spectroscopy.** Huie, C.W.; Yeung, E.S. (Ames Laboratory and Department of Chemistry, Iowa State University, Ames Iowa 50011). *Applied Spectroscopy;* **38**: No. 5, 660-663(Sep 1984). Contract W-7405-ENG-82.

A highly collimated laser beam is used to observe molecular absorption in a premixed air-acetylene flame by providing a two-dimensional image on a vidicon camera. Spatially resolved molecular concentrations can thus be obtained in 1/60 second. By measurement of the relative intensities of absorption from different vibrational levels in the ground state of the molecules, a vibrational temperature can be derived for each of the spatial regions in the flame. This information is directly relevant to the understanding of dissociation in flames.

7187 **Laser-induced fluorescence of flowing samples as an approach to single-molecule detection in liquids.** Dovichi, N.J.; Martin, J.C.; Jett, J.H.; Trkula, M.; Keller, R.A. (Los Alamos National Lab., NM). *Analytical Chemistry;* **56**: No. 3, 348-354(Mar 1984).

A flow cytometer system was used to detect aqueous rhodamine 6G by laser-induced fluorescence. Best results were obtained with careful spectral and spatial filtering. At the detection limit, the probability of a rhodamine 6G molecule being present in the detector's probed volume of 11 pL is about 0.6 . With a flow rate of 0.42 μL/s, a detection limit of $8.9 \times 10^{-14}$ M was obtained for a 1-s time constant. At the detection limit, 18 ag or 22,000 molecules of rhodamine 6G flowed through the probed volume during the signal integration period. Signal linearity extends over greater than 5 orders of magnitude limited only by saturation of the detection electronics at high concentration. The results presented here allow a projection to single-molecule detection with reasonable improvements to the apparatus. 25 references, 5 figures, 7 tables.

7188 **Cation selectivity in a toluene emulsion membrane system.** Izatt, R.M.; Dearden, D.V.; Witt, E.R.; McBride, D.W. Jr.; Christensen, J.J. (Brigham Young Univ., Provo, UT). *Solvent Extraction and Ion Exchange;* **2**: No. 3, 459-477(1984). Contract AC02-78ER05016.

Metal separations from various mixtures of alkali metal, alkaline earth metal, $Cu^{2+}$, $Zn^{2+}$, $Ag^{+}$, $Tl^{+}$, and $Pb^{2+}$ nitrates were studied using an emulsion membrane system. The membrane consisted of a water-in-oil emulsion composed of 0.050 M $Li_4P_2O_7$ in $H_2O$ and 0.020 M dicyclohexano-18-crown-6 (DC18C6) in toluene with sorbitan monooleate serving as surfactant. The emulsion was placed into an aqueous source phase solution of the metal nitrates of interest. Of the cations studied, $Pb^{2+}$ was transported most rapidly and selectively. The selectivity of the system for particular cations is governed by the relative M/sup n+/-DC18C6 and M/sup n+/-$P_2O_7^{4-}$ complex stabilities. Formation of a sufficiently stable M/sup n+/-DC18C6 complex is necessary to partition cations into the toluene membrane, and formation of a more stable M/sup n+/-$P_2O_7^{4-}$ complex is necessary to strip cations from the membrane into the receiving phase. 17 references, 2 figures, 6 tables.

7189 **Chemical amplification of optoacoustic signals.** O'Connor, M.T.; Diebold, G.J. (Brown Univ., Providence, RI). *Nature (London);* **301**: No. 5898, 321-322(27 Jan 1983).

Historically, the optoacoustic effect has been produced in gases through the absorption of IR radiation. As the effect depends only on the conversion of modulated radiation to periodic heating of the gas (which in a closed vessel is equivalent to a sound wave), it is not surprising that the optoacoustic effect can be produced by several different interactions where radiation is absorbed by matter. Here generation of the optoacoustic effect by photochemical release of energy through a chain reaction mechanism in $H_2$-$Cl_2$ mixtures is reported. A unique feature of the optoacoustic effect produced in this manner is chemical amplification of the acoustic signal caused by a release of energy from the chemical reactions that is greater than the energy absorbed from the light beam. In addition, because the acoustic signal depends on the kinetics of the reaction and the time dependent concentrations of the reactants, the optoacoustic effect acts to monitor directly the progress of the reaction in time. 7 references, 2 figures.

7190 **Metal separation using emulsion liquid membranes.** Izatt, R.M.; Dearden, D.V.; McBride, D.W. Jr.; Oscarson, J.L.; Lamb, J.D.; Christensen, J.J. (Brigham Young Univ., Provo, UT). *Separation Science and Technology;* **18**: No. 12-13, 1113-1129(1983). Contract AC02-78ER05016.

Emulsion membrane systems consisting of an aqueous metal salt source phase, a toluene membrane containing the macrocyclic ligand dicyclohexano-18-crown-6 (DC18C6) (0.02 M) and the surfactant sorbitan monooleate (3% v/v), and an aqueous 0.05 M $Li_4P_2O_7$ receiving phase were studied with respect to the disappearance of metal from the source phase as a function of time. The salts $Pb(NO_3)_2$, $Sr(NO_3)_2$, $TlNO_3$, and $LiNO_3$ were studied both singly and in mixtures of $Pb(NO_3)_2$ with each of the other salts. In all mixtures studied, $Pb^{2+}$ was transported first, followed by the second cation (except $Li^{+}$ which was not transported). An excess of a second salt with a common anion enhanced the transport of $Pb^{2+}$. Modeling of these systems was discussed. Source phases containing basic (pH 11) $K[Al(OH)_4]$ solutions were studied using the same membrane and a 0.15 M $H_3PO_4$ receiving phase. $K^{+}$ and Al(III) (as aluminate anion) were both found to transport in this system, but no transport of Al(III) and little transport of $K^{+}$ were detected when DC18C6 was absent.

7191 **High-capacity pressurized continuous chromatograph.** Begovich, J.M.; Byers, C.H.; Sisson, W.G. (Oak Ridge National Lab., TN). *Separation Science and Technology;* **18**: No. 12-13, 1167-1191(1983). Contract W-7405-ENG-26.

Multicomponent liquid chromatographic separations have been achieved by using a slowly rotating annular bed of sorbent material. The feed material is continuously introduced at a stationary point at the top of the bed, and eluent is allowed to flow everwhere else around the annulus. The rotation of the sorbent bed causes the separation components to appear as helical bands, each of which has a characteristic, stationary exit point; hence the separation process is truly continuous. The concept has been developed primarily on a 279-mm-diam by 0.6-m-long device with a 12.7-mm-wide annulus. The effects of annulus width and diameter have been studied using the same device with annulus widths up to 114.3 mm. With this largest width, approximately 96% of the area available within the outer cylinder is devoted to the rotating sorbent bed. Further annulus-width studies have been pursued on units with 89- and 445-mm diameters. These geometric extensions to the basic concept allow extremely large capacity increases with minimal loss in separation and no increase in chromatograph diameter. The effects associated with increased feed concentration have also been studied. In this effort as well as in the annulus-width program, the separation of copper, nickel, and cobalt components from a carbonate solution was studied in detail. The nickel and cobalt components are found in the leach liquor of the Caron process for recovering nickel and cobalt from laterite ores. Nominally 50-μm0-diam Dowex 50W-X8 cation exchange resin was used as the bed material. The nickel concentration of the feed was varied tenfold, from 136.1 to approximately 1400 meq/L. The combined effects of the bed loading and annulus width were studied and compared with nonlinear theory.

7192 **Analysis of gas purification by pressure swing adsorption: priming the parametric pump.** Knaebel, K.S.; Hill, F.B. (Ohio State Univ., Columbus). *Separation Science and Technology;* **18**: No. 12-13, 1193-1219(1983).

The transients during startup of a pressure-swing adsorber (PSA) lead to material and energy losses. A dynamic mathematical model is developed to analyze the PSA process to elucidate the conditions under which losses may be minimized. It is based on an ideal binary mixture comprised of components that have linear isotherms. A processing alternative that virtually eliminates losses is suggested. The alternative is formulated by considering the PSA process as a specific type of parametric pump. It follows intuitively that, as in an ordinary pump, the parametric pump will commence operation at steady-state if it is primed. In the case of PSA, that amounts to purging the initial adsorber contents with the less strongly adsorbed component. Illustrations are provided of both single-bed and dual-bed processes. For a specific gas mixture and adsorbent, the effect of varying the ratio of the high and low pressures that occur in a cycle is examined. Results indicate that there is a significant advantage in priming the single-bed version because of the surge tank, which promotes backmixing. There is still an advantage in priming the dual-bed version, however, despite the absence of backmixing.

7193 **Filtration behavior of suspensions of uniform polystyrene particles in aqueous media.** Bridger, K.; Tadros, M.; Leu, W.; Tiller, F. (Martin Marietta Laboratories, Baltimore, MD). *Separation Science and Technology;* **18**: No. 12-13, 1417-1438(1983). Contract AS05-81ER10946.

Cake filtration experiments of suspensions of polystyrene particles, of uniform morphology, through Nuclepore membranes having uniform pores were carried out. The effects of particle properties (size and surface charge), suspension properties (particle concentration and ionic strength), and applied pressure were determined. The results were analyzed in terms of the conventional Darcy-Ruth filtration equation. Plots of resistance versus weight of solids in the cake revealed two distinct regions with a transition occurring early on in the filtration process at a cake thickness of the order of 1 mm. The initial portion has a lower average slope (specific resistance) than that of the second region. It is by only plotting this second region (i.e. ignoring the initial stages of the filtration process) that apparent negative values for the medium resistance are obtained. The specific cake resistance obtained from the slope of the second region, which spans at least 90% of the filtration time, was correlated with particle and dispersion properties. The specific filtration resistance was essentially independent of slurry concentration and of the total applied pressure. Specific cake resistance measured at constant pressure and slurry concentration showed an inverse dependence on ionic strength. This effect was more pronounced near the critical coagulation concentration and the filter cakes produced were more porous than those at the lower ionic strengths. These results will be discussed on the basis of variations in both the medium as well as the cake resistances during the course of filtration.

7194 **Investigations of ion-size-selective synergism in solvent extraction.** McDowell, W.J.; Case, G.N.; Aldrup, D.W. (Oak Ridge National Lab., TN). *Separation Science and Technology;* **18**: No. 14-15, 1483-1507(1983).

Organophilic crown ethers and other similar macrocyclic compounds produce a synergistic enhancement of the extraction of several metal ions by organic-phase-soluble carboxylic, phosphoric, and sulfonic acids. Ions examined include the alkali metals, the alkaline earths, and some first-row transition elements. In many cases, the synergistic effects are clearly related to the correspondence of the ion size to the macrocycle cavity diameter. In other cases this is less true, and occasionally, complete lack of synergism or even antagonism is observed. These phenomena have been investigated by systematic studies of the systems involved, by equilibrium studies of selected extraction systems, and by vapor-pressure osmometric studies of the intermolecular bonding between the organic-phase macrocycles and acids. Lack of synergism (when it is expected from size correspondence) does not appear to be due to bonding interactions between the macrocycle and the extractant acid. Other considerations suggest that synergism may depend on the degree to which the macrocycle can surround the ion. Possibilities for metal ion separations are noted, and the directions for further, needed investigations are indicated. 18 references, 14 figures, 2 tables.

7195 **Drop-interface coalescence rate in tertiary amine solvent extraction.** Moyer, B.; McDowell, W.J. (Oak Ridge National Lab., TN). *Separation Science and Technology;* **18**: No. 14-15, 1535-1562(1983). Contract W-7405-ENG-26.

An important requirement for economical application of solvent extraction technology is rapid and efficient phase disengagement. However, much progress toward a clear fundamental understanding of the factors that affect phase disengagement rate will be needed before a logical approach to the problem will be possible. In this paper, the conceptual framework for the study of drop-interface coalescence in collapsing liquid/liquid dispersions is developed and the details of the experimental setup employed in the initial work are presented. The method for determining the drop-interface coalescence rate requires measurement of the average volume of drops (v/sub f/) adjacent to the interface, their number (n) per unit area of interface, and dispersed-phase throughput (Q) per unit area. Recording videomicrography for measurement of v/sub f/ and n is employed while Q is found from the changing position of the major interface as the dispersion band collapses (batch mode). Experimental results are presented for the highly purified system 0.1 M trioctylamine in o-xylene vs 0.1 M HCl, 0.9 M LiCl. Successive batch phase-mixing runs (1:1 phase ratio) using this system produced highly reproducible results, attributed to the use of high-purity chemicals and noncontaminating cell construction materials. Wall effects were found to be negligible. The results indicated that the changing throughput observed in batch experiments is brought about not only by drop size growth rates, but also by drop packing behavior and the fact that drop-interface coalescence rate changes with time.

7196 **Operation with three liquid phases in a staged liquid-liquid contactor.** Leonard, R.A.; Ziegler, A.A.; Wigeland, R.A.; Bane, R.W.; Steindler, M.J. (Argonne National Lab., IL). *Separation Science and Technology;* **18**: No. 14-15, 1563-1579(1983). Contract W-31-109-ENG-38.

Operation with three liquid phases was demonstrated in a staged liquid-liquid contactor. The possibility that three liquid phases could be handled in a liquid-liquid contactor normally used with two liquid phases was initially established using a laboratory batch test. The three liquid phases were obtained using a thorium flow sheet having high concentrations of both acid and thorium. To analyze the batch test, the concept of a dimensionless dispersion number for use with two liquid phases was extended so that it could be applied to three liquid phases. Based on the batch tests, continuous flow tests were run in a staged liquid-liquid contactor used for solvent extraction. A critical factor in the success of these tests was determining the position of the liquid-liquid interface in the contactor. Thus, a contactor was used which allows the position of the liquid-liquid interface to be adjusted. Actual three-phase operation was demonstrated using a 4-cm annular centrifugal contactor, albeit with a somewhat greater (3-4 vol. %) aqueous-phase contamination of the organic exit stream than normal (<1 vol. %).

7197 **Synergistic extraction of $Sm(NO_3)_3$ and $Gd(NO_3)_3$ by a mixture of tributyl phosphate and Aliquat 336 in AMSCO and ammonium nitrate medium.** Huang, C.H.; Bautista, R.G. (Iowa State Univ., Ames). *Separation Science and Technology;* **18**: No. 14-15, 1667-1683(1983). Contract W-7405-ENG-82.

The synergic extraction of Sm and Gd using a mixture of tributyl phosphate and Aliquat 336 is presented. The influence of diluents, salting out agents and acidity on the synergic extractions have been investigated. The separation factor of Sm and Gd was found to be larger than 3. This is one of the best systems for the separation of Sm and Gd. $NH_4NO_3$ was found to be extracted by pure TBP or pure Aliquat 336, but cannot be extracted by a mixture of TBP and Aliquat 336. 8 references, 6 figures, 4 tables.

7198 **Extraction of 3d transition metals from molten cesium-sodium-potassium/acetate eutectic into dodecane using organophosphorous ligands.** Maroni, V.A.; Philbin, C.E.; Yonco, R.M. (Argonne National Lab., IL). *Separation Science and Technology;* **18**: No. 14-15, 1699-1713(1983).

Measurements have been made of the transfer of the transition metal cations $Cr^{3+}$, $Fe^{2+}$, $Co^{2+}$, $Ni^{2+}$ from molten cesium acetate-sodium acetate-potassium acetate eutectic (50-25-25 mol%, mp ~ 90°C) into dodecane solutions containing selected acidic and neutral organophosphorous extracting ligands. The ordering of the transition metals according to their relative extents of extraction into the dodecane phase when the ligand bis(2-ethylhexyl)-phosphinic acid, H[DEPH], is employed (and the conditions of extraction are the same for each cation) is $Co^{2+} > Fe^{2+} > Cr^{3+} > Ni^{2+}$. Comparisons of results obtained using the acidic ligand H[DEPH] and the neutral ligand tri-n-octylphosphine oxide, TOPO, indicate that the extractible TM complex does not contain acetate as a charge neutralizing ligand, but rather requires complete displacement of inner sphere acetate ions by protonated and/or deprotonated alkylphosphinate groups. The mechanism controlling the transfer kinetics has not been elucidated, but the rates of extraction from the acetate eutectic appear to be somewhat slower than has been observed for the extraction of transition metals from molten alkali metal thiocyanate and nitrate media at comparable temperatures, i.e., 140 → 180°C. 13 references, 2 figures, 2 tables.

7199 **Approaches toward synthesizing novel extractant systems: polymeric bifunctional extractants with synergistic possibilities.** Alexandratos, S.D.; McDowell, W.J. (Univ. of Tennessee, Knoxville). *Separation Science and Technology;* **18**: No. 14-15, 1715-1730(1983).

The synthesis of a monoarylphosphinic acid diarylphosphine oxide extractant system supported on macroporous polystyrene beads is reported. The bifunctional resin was used in separate zinc and copper(II) ion extraction studies. Results with both metals show an excellent extent of extraction under low loading conditions and solution pH of 1-2; at equivalent metal:resin concentrations, the resin absorbs 50% of the metal in solution. Comparison with lower absorption values reported in the literature for similar systems suggests the possibility of a synergistic extraction due to cooperation between the acid and oxide moieties. 30 references.

7200 **Multidimensional phosphorimetry.** Ho, C.N.; Warner, I.M. *TrAC, Trends in Analytical Chemistry (Personal Edition);* **1**: No. 7, 159-163(Mar 1982).

Phosphorescence analysis of multicomponent samples can be enhanced by the rapid acquisition of multiparametric data. A new approach to phosphorimetry provides a sensitive and selective analytical technique through the acquisition of phsophorescence data in the form of an emission-excitation matrix.

## 4002 Inorganic And Physical Chemistry

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7201 **(IC—84/10) Structure and thermodynamic properties of molten rubidium chloride.** Ballone, P.; Pastore, G.; Tosi, M.P. (International Centre for Theoretical Physics, Trieste (Italy)). Feb 1984. 9p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85780153.

Self-consistent calculations of partial pair distribution functions and thermodynamic properties are presented for molten RbCl in a non-polarizable-ion model and compared with computer simulation data. The theory, which is quantitatively very successful, hinges on an empirical evaluation of bridge diagrams including both excluded-volume effects and long-range Coulomb effects.

7202 **(IC—84/14) Nonmetal-metal transition in molten potassium-potassium halide solutions.** Senatore, G.; Tosi, M.P. (International Centre for Theoretical Physics, Trieste (Italy)). Mar 1984. 6p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85780154.

It is suggested, in the light of the available experimental evidence, that the nonmetal-to-metal transition in solutions of potassium in molten potassium halides may be viewed as a volume-percolation transition. The critical concentration is estimated and differences between alkali-alkali halide and metal-ammonia solutions are discussed.

7203 **(NP—5900160) Alkali metal phosphides and the lower hydrides of phosphorus. Final report.** Evers, E.C. (Pennsylvania Univ., Philadelphia (USA). Dept. of Chemistry). 3 Mar 1955. 91p. NTIS, PC A05. File Number DE85900160.

Procedures employed in the preparation of $Li_4P_2$, $Na_4P_2$, $KNa_3P_2$, $KLi_3P_2$, $K_4P_4$, $KPH_2$ and $NaPH_2$ in liquid ammonia are described. The chemical interrelation of these substances are discussed, and in particular, the structures of the polyphosphides are considered as exemplified by their chemical properties. It is demonstrated, for example, that $Na_4P_2$ and its ammonolysis product, $Na_2H_2P_2$, may be looked upon as being derived from the parent acid, biphosphine, $H_4P_2$. Furthermore, it is shown that $Na_4P_2$ may be reduced to $NaPH_2$ under suitable conditions, and that $H_4P_2$ may be converted to the same compound by reduction with sodium. It was necessary to prepare and have available considerable quantities of biphosphine. This study lead to an improved method of synthesis, employing the hydrolysis of calcium phosphide. Finally, the decomposition of biphosphine, both in the absence of solvent and in liquid ammonia at -34°, was investigated.

7204 **Electronic properties of the linear antiferromagnetically coupled clusters $[Fe_3S_4(SR)_4]^{3-}$, structural isomers of the $[Fe_3S_4]^+$ unit in iron-sulfur proteins.** Girerd, J.J.; Papaefthymiou, G.C.; Watson, A.D.; Gamp, E.; Hagen, K.S.; Edelstein, N.; Frankel, R.B.; Holm, R.H. (Harvard Univ., Cambridge, MA). *Journal of the American Chemical Society;* **106**: No. 20, 5941-5947(3 Oct 1984). Contract AC03-76SF00098.

The magnetic susceptibility, magnetism, and Moessbauer spectroscopic properties of organometallic iron sulfide complexes of the form $[Fe_3S_4(SR)_4]^{3-}$ where R is an ethyl or phenyl group are reported. Almost all structurally defined native and synthetic Fe-S-SR clusters containing at least one formal Fe(III) atom exhibit two especially prominent geometric features: 1) cores are, or are built up from bridged or fused, rhombiodal $Fe_2S_2$ groups within which Fe...Fe separation is approximately 2.74 A and 2) Fe atoms reside in (distorted) $FeS_4$ sites. Close resemblance of the Moessbauer spectra of the complex in the solid and in dimethylformamide solutions demonstrates the retention of the linear structure in solution. The hyperfine structures of the complexes are explained on the basis of two magnetic subsites observed in a 2:1 ratio. Alternative site structures based on tetrahedral coordination and Fe...Fe separations of the 2.7 A are presented, and existing topological equivalents of these structures are noted. The linear structure has been recently shown to occur in an unfolded form of aconitase.

7205 **Bond energies on the cesium halides determined by collision-induced dissociation.** Parks, E.K.; Wexler, S. (Argonne National Lab., IL). *Journal of Physical Chemistry;* **88**: No. 20, 4492-4494(27 Sep 1984). Contract W-31-109-ENG-38.

The bond energies of the four cesium halides are determined from the threshold for collision-induced dissociation to ion pairs by rare gas atoms. The bond energies (to neutral atoms) are 5.32 +/- 0.08, 4.58 +/- 0.08, 4.00 +/- 0.08, and 3.47 +/- 0.15 eV for CsF, CsCl, CsBr, and CsI, respectively. Except for CsI the ion thresholds are obtained from the sharply peaked cross section vs. energy curves for $CsM^+ + X^-$ formation (M = rare gas atom; $X^-$ = halide ion) and for CsI the ion threshold is obtained from the onset of the channel $M + Cs^+ + I^-$. Comparison is made with bond energies determined by other techniques as well as that derived from the T-Rittner model potential.

7206 **Core binding energies of the boron trihalides, Lewis acidities of the boron trihalides, and heats of formation of carbonium ions.** Beach, D.B.; Jolly, W.L. (Univ. of California, Berkeley). *Journal of Physical Chemistry;* **88**: No. 20, 4647-4649(27 Sep 1984). Contract AC03-76SF00098.

The core electron binding energies of the boron trihalides have been redetermined. The data are used, in conjunction with literature valence ionization potentials, to establish the extent of halogen-boron $\pi$ bonding and, in conjunction with thermodynamic data, to determine the core replacement energy of carbonium ions.

7207 **Interaction of physisorbed species with chemisorbed species as studied by infrared spectroscopy.** Yates, J.T. Jr.; Haller, G.L. (National Bureau of Standards, Washington, DC). *Journal of Physical Chemistry;* **88**: No. 20, 4660-4664(27 Sep 1984).

Infrared spectroscopy has been used to study the physical adsorption of CO onto a $Rh/Al_2O_3$ surface. In addition to absorption bands related to monolayer and multilayer physisorbed CO species, an interaction between the physisorbed species and chemisorbed CO has been observed causing a decrease of the chemisorbed CO wavenumber. Similar effects between physisorbed Xe and chemisorbed $N_2$ on Rh surfaces have also been observed, suggesting that the effect is a general one. Correlation of these measurements with measurements of CO trapped in CO matrices suggests that inductive and dispersive effects are the main factors responsible for the negative shift in chemisorbed species wavenumber. It has been found that physisorbed CO preferentially adsorbs in the vicinity of ionic sites, and that the change in entropy of adsorption is approximately equal to 5.6 +/- 2 kcal $mol^{-1}$ for CO physisorption near Rh/sup I/$(CO)_2$ species.

7208 **Structural studies of salts of cis and trans $\mu$-fluoro-bridged polymers of $GeF_5^-$ and of the $GeF_5^-$ monomer.** Mallouk, T.E.; Desbat, B.; Bartlett, N. (Univ. of California, Berkeley). *Inorganic Chemistry;* **23**: No. 20, 3160-3166(26 Sep 1984). Contract AC03-76SF00098.

The crystal and molecular structures of the compounds $XeF_5$ $GeF_5$ and $ClO_2^+$ $GeF_5^-$ are reported. Both compounds are orthorhombic, but $XeF_5$ $GeF_5$ contains infinite chains of $GeF_6$ octahedra sharing transvertices while in $ClO_2^+$ $GeF_5^-$ the $GeF_6$ units are joined by sharing cis vertices. In $XeF_5$ $GeF_5$, the $XeF_5$ cations are arranged alternately to the left and right along the chains such that each cation approaches symmetrically two of the $\mu$-fluoro-bridged $GeF_6$ units. The nonbridging $GeF_4$ units are planar and approximately square. The $ClO_2^+$ $GeF_5^-$ is an infinite helix having all the Ge atoms of the chain nearly coplanar. Infrared and Raman spectra of both compounds are reported. Similarities of the vibrational spectra of $ClO_2^+$ $GeF_5^-$ to the spectra of the $O_2^+$ salt indicated that the same anion occurs in both.

7209 **Fluoride ion affinities of $GeF_4$ and $BF_3$ from thermodynamic and structural data for $(SF_3)_2GeF_6$, $ClO_2GeF_5$, and $ClO_2BF_4$.** Mallouk, T.E.; Rosenthal, G.L.; Mueller, G.; Brusasco, R.; Bartlett, N. (Univ. of California, Berkeley). *Inorganic Chemistry;* **23**: No. 20, 3167-3173(26 Sep 1984). Contract AC03-76SF00098.

Results of studies to determine the fluoride ion affinity in $GeF_4$ and $BF_3$ are presented herein. Thermodynamic and structural data for $(SF_3)_2GeF_6$, $ClO_2GeF_5$, and $ClO_2BF_4$ are tabulated. The first fluoride ion affinity of $GeF_4$ was found to be 4-8kcal more energetic than that of $BF_3$. The packing volume of the $BF_4^-$ ion was found to be 16 +/- 2 $A^3$ which is less than the smaller $GeF_5^-$. It is noted that in small-cation structures, with close-packed ion arrangements, the lattice energy of fluoroborates can be approximately 5kcal $mol^{-1}$ more favorable than for related fluorogermanates. Thus for this type of salts, the better fluoride acceptor ability of $GeF_4$ is largely offset by a poorer lattice energy, with the lattice difference decreasing as the cation becomes larger.

**7210 Desolvation method for assessment of crystallization energies and ion crowding in rare-earth perchlorates, chlorides, and nitrates.** Onstott, E.I.; Brown, L.B.; Peterson, E.J. (Los Alamos National Lab., NM). *Inorganic Chemistry;* **23**: No. 16, 2430-2435(1 Aug 1984).

Gibbs energy changes on removal of solvent water to crystallize rare-earth perchlorates, chlorides, and nitrates from saturated solutions have been computed from activity data in the literature. These values are combined with heat of dilution data to give second-law entropy changes. Perchlorates and chlorides require about the same Gibbs energy change for crystal formation, although the saturated solution compositions are considerably different. Nitrates require about half of the Gibbs energy change required for perchlorates and chlorides. The work requirement for crystallization of $[Pr_2Cl_2(H_2O)_{14}]Cl_4$ is 500 cal $mol^{-1}$ less than for $[NdCl_2(H_2O)_8]_2Cl_2$. Exothermic heat results from crystallization of the former compound, while heat absorption results from crystallization of the latter. All nitrates evolve heat on crystallizing. Second-law values of T$\Delta$S show that the cation-stabilization energy of $[Pr_2Cl_2(H_2O)_{14}]Cl_4$ vs. $[PrCl_2(H_2O)_8]_2Cl_2$ is 150 cal $mol^{-1}$. Entropy changes on crystallization are positive only for perchlorates with atomic numbers larger than that of dysprosium. 32 references, 4 figures, 3 tables.

**7211 Low-temperature neutron diffraction analysis of $[Rh_4(eta^5\text{-}C_5Me_5)_4H_4][BF_4]_2$.** Ricci, J.S.; Koetzle, T.F.; Goodfellow, R.J.; Espinet, P.; Maitlis, P.M. (Brookhaven National Lab., Upton, NY). *Inorganic Chemistry;* **23**: No. 13, 1828-1831(20 Jun 1984).

A low-temperature (12 K) neutron diffraction study of $[Rh_4(eta^5\text{-}C_5Me_5)_4H_4][BF_4]_2$ has been performed to determine whether the hydride ligands bridge the edges or faces of the tetranuclear rhodium cluster. Both anions and cations lie on sites of 4-$S_4$ symmetry. The cation is a stable, 58-electron, diamagnetic complex consisting of a tetrarhodium cluster with a $C_5Me_5$ ligand attached to each metal. The $Rh_4$ core shows substantial distortion from a regular tetrahedron, resulting in four long and two short Rh-Rh distances. The hydrides were found to bridge the faces of the tetrarhodium cluster at a distance of 0.96 A above the planes formed by three Rh atoms. The Rh-Rh distances are 2.610 (5) and 2.829 (5) A, and the Rh atoms are 1.84 A from the $C_5$-ring planes. A detailed $^1H$ and $^{13}C$ NMR analysis establishes that the hydride ligands also are face bridging in solution. Calculations based on idealized tetrahedral geometry for the molecular framework show no abnormally short nonbonded contacts, and thus distortion from T/sub d/ symmetry appears to be electronic rather than steric in origin. Crystallographic data for $[C_{40}H_{64}Rh_4][BF_4]_2$: tetragonal, space group Ianti 4, Z = 2, a = 11.459 (3) A, c = 15.481 (8) A, $R(F^2) = 0.069$ for 1371 reflections with (sin theta)/$\lambda < 0.83$ $A^{-1}$. 22 references, 4 figures, 4 tables.

**7212 Ligand steric effects on the photophysics of bis- and tris(2,2'-bipyridine) complexes of rhodium(III).** Nishizawa, M.; Suzuki, T.M.; Sprouse, S.; Watts, R.J.; Ford, P.C. (Univ. of California, Santa Barbara). *Inorganic Chemistry;* **23**: No. 13, 1837-1841(20 Jun 1984).

The effects of 3,3'-dimethyl steric interactions on the luminescence of 2,2'-bipyridine complexes of rhodium(III) have been investigated. The tris complex, $Rh(dmbpy)_3^{3+}$, is found is display both metal-centered and ligand-centered emissions. The metal-centered emission is the dominant luminescence feature at 77 K, but the ligand-centered emission is enhanced relative to the metal-centered luminescence in fluid solutions. The bis complex, $Rh(dmbpy)_2Cl_2^+$, displays a dominant ligand field emission under all conditions that were studied. Reinvestigation of the luminescence of the tris(1,10-phenanthroline) and tris(2,2'-bipyridine) complexes of Rh(III) in fluid solutions indicates that these species emit only from ligand-centered excited states. Comparison of the 3,3'-dimethyl-2,2'-bipyridine and unsubstituted 2,2'-bipyridine complexes of Rh(III) indicates that both ligand-centered and metal-centered excited states have lower energies for the methyl-substituted complexes but the effect if larger for the metal-centered states. 21 references, 7 figures, 1 table.

**7213 Application of lanthanide induced shifts for the determination of solution structures of metal ion-extractant complexes.** Kalina, D.G. (Argonne National Lab., IL). *Solvent Extraction and Ion Exchange;* **2**: No. 3, 381-404(1984). Contract W-31-109-ENG-38.

An analysis of the induced shifts in the nuclear magnetic resonance (NMR) spectra of extractants complexed to paramagnetic lanthanide ions has been performed. The complexes of a number of monofunctional and bifunctional extractants have been examined and assigned solution structures by minimizing the differences between the observed shifts and those calculated using a computer analysis in which the potential configurations of the complexes were generated. Complexes of monofunctional extractants were calculated to have coordination geometries quite similar to those observed in related compounds by crystallographic techniques. For the bifunctional extractants, differentiation between monodentate and bidentate coordination seems possible. 23 references, 2 figures, 7 tables.

**7214 Thermodynamics of aqueous sodium chloride to 823 K and 1 kilobar (100 MPa).** Pitzer, K.S.; Li, Y. (Univ. of California, Berkeley). *Proceedings of the National Academy of Sciences of the United States of America;* **80**: 7689-7693(Dec 1983). Contract AC03-76SF00098.

It is shown that a very simple semiempirical equation represents quite accurately the thermodynamic properties of aqueous sodium chloride from 373 to 823 K. The equation comprises one Margules term and a Debye-Hueckel term. Just the one Margules parameter is freely adjustable because the Debye-Hueckel parameter is determined by the properties of water. The equation is valid from the saturation composition down to infinite dilution for solvent density above 0.75 $g.cm^{-3}$ but at lower density only above a solute mole fraction of about 0.1 on an ionized basis. Both solute and solvent activity coefficients are fitted from the lowest pressure of solution existence up to 1 kilobar (1 bar = 100 kPA). Derivation of enthalpy and other related functions is discussed. 29 references, 7 figures, 2 tables.

**7215 Catalytic activation of molecular hydrogen in alkyne hydrogenation reactions by lanthanide metal vapor reaction products.** Evans, W.J.; Bloom, I.; Engerer, S.C. (Univ. of California, Irvine). *Journal of Catalysis;* **84**: No. 2, 468-476(Dec 1983).

A rotary metal vapor was used in the synthesis of Lu, Er, Nd, Sm, Yb, and La alkyne, diene, and phosphine complexes. A typical catalytic hydrogenation experiment is described. The lanthanide metal vapor product is dissolved in tetrahydrofuran or toluene and placed in a pressure reaction vessel 3-hexyne (or another substrate) is added, the chamber attached to a high vacuum line, cooled to -196°C, evacuated, warmed to ambient temperature and hydrogen is added. The solution is stirred magnetically while the pressure in monitored. The reaction products were analyzed by gas chromatography. Rates and products of various systems are listed. This preliminary survey indicates that catalytic reaction chemistry is available to these metals in a wide range of coordination environments. Attempts to characterize these compounds are hampered by their paramagnetic nature and their tendency to polymerize.

**7216 Chemistry of metal chloride complexes in aprotic systems.** Felker, L.K.; Kelmers, A.D. (Oak Ridge National Lab., TN). *Separation Science and Technology;* **18**: No. 14-15, 1439-1453(1983). Contract W-7405-ENG-26.

A study of metal chloride solubility in aprotic solvents has been initiated. These solvent systems have very low hydrogen ion

activities and thus allow chloride ion activities which are much higher than those attainable in water. The high chloride ion activities can be generated by the dissolution of soluble salts, such as calcium chloride or sodium chloride, in the aprotic media. Metals that normally form aqueous-insoluble chlorides or exist as cations in aqueous solutions (e.g., Ag, Pb, Cd, or Au) may be readily dissolved in aprotic solvent systems as anionic chloride complexes or as solvation complexes. To understand such systems, the authors construct ternary phase diagrams for dimethylsulfoxide-water-calcium chloride (DMSO-$H_2O$-$CaCl_2$) and DMSO-$H_2O$-NaCl systems. These diagrams were used to establish the solution regions available for the solubilization of Pb, Ag, Au, Cd, Cu, Zn, and Al. Dissolution/precipitation steps, controlled by varying the ternary system composition, could lead to the development of useful methods for recovering, purifying, or separating various metal chloride compounds. 9 references, 6 figures, 3 tables.

## 4003 Organic Chemistry

*REFER ALSO TO CITATION(S) 4003006553, 7204, 7206, 7211, 7212, 7213, 7250, 7374*

7217 **(DOE/ER/04062—91) Eldor investigations of radiation processes. 1983-1984 annual informal technical report.** Kispert, L.D. (Alabama Univ., University (USA). Dept. of Chemistry). 1984. Contract AS05-76ER04062. 5p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85003240.

Attempts are being made to measure the photoexcited singlet, doublet, and triplet state lifetimes of carotenoids by spectroscopy, EPR, and electron spin echo. (DLC)

7218 **Synthesis, characterization, and equilibria of palladium(II) nitrile, alkene, and heterometallacyclopentane complexes involved in metal nitro catalyzed alkene oxidation reactions.** Andrews, M.A.; Chang, T.C.T.; Cheng, C.W.F.; Emge, T.J.; Kelly, K.P.; Koetzle, T.F. (Brookhaven National Lab., Upton, NY). *Journal of the American Chemical Society;* **106**: No. 20, 5913-5920(3 Oct 1984).

The synthesis and characterization of representative examples of palladium(II) nitrile, alkene, and heterometallacyclopentane complexes are described in detail. These complexes are all in rapid equilibrium with each other under the reaction conditions examined. Although quantitative data regarding the equilibria are not obtainable, qualitative kinetic and thermodynamic observations are presented that are relevant to the extensive Pd(II)-mediated chemistry of alkenes. Typical metallacycles are also involved in bridge cleavage and possible ring-opening equilibria.

7219 **Products, radical intermediates, and hydrogen atom production in the thermal decomposition of 1,2-dihydronaphthalene.** Franz, J.A.; Camaioni, D.M.; Beishline, R.R.; Dalling, D.K. (Pacific Northwest Lab., Richland, WA). *Journal of the American Chemical Society;* **106**: No. 20, 3563-3570(3 Oct 1984). Contract AC06-76RL01830;AC02-79ER10510.

The thermal decomposition of 1,2-dihydronaphthalene (DHN) at 300° produces tetralin, naphthalene, hydrogen, and five $C_{20}$ hydrocarbon products. The isolation of five $C_{20}$ hydrocarbon compounds revealed that two of the compounds are formed by the addition of 2-hydronaphthyl to DHN followed by intramolecular cyclization and hydrogen abstraction. A third compound was formed by the addition of the 1-tetralyl radical to DHN followed by hydrogen abstraction, and the other two compounds were formed by a sequence involving initial addition of 2-tetralyl radical to DHN. The thermal decomposition of DHN at 400-450°C leads to the formation of a hydrogen atom which participates in subsequent hydrocracking reactions of available substituted aromatic structures.

7220 **Electrospray ion source: another variation on the free-jet theme.** Yamashita, M.; Fenn, J.B. (Yale Univ., New Haven, CT). *Journal of Physical Chemistry;* **88**: No. 20, 4451-4459(27 Sep 1984).

Solutions passed through a small capillary at 2-10 kV relative to ground are electrosprayed into a bath gas to form a gaseous dispersion of ions that is expanded into vacuum in a small supersonic free jet. A portion of the jet is passed through a skimmer to form a molecular beam that contains a variety of ionic species. Mass spectrometric analysis reveals that these species include solute cations in aggregation with solvent molecules and/or nonionized solute species. The nature of the product ions depends upon the composition and feed rate of the original solution, the temperature and composition of the bath gas, and the voltage applied to the capillary. The exploratory experiments reported here suggest that this novel ion source may be useful for producing in vacuo a wide variety of cluster ions for examination by various spectroscopic techniques. Also inviting is the prospect of extending the applicability of mass spectrometric analysis to large organic molecules that are too complex, too fragile, or too nonvolatile for ionization by more conventional methods. Another intriguing possibility is to use the technique on probing the microscopic structure and properties of solutions.

7221 **Mechanism of palladium(II)-catalyzed C=C bond isomerization in olefins.** Sen, A.; Lai, T.W. (Pennsylvania State Univ., University Park). *Inorganic Chemistry;* **23**: No. 20, 3257-3258(26 Sep 1984).

The commonly postulated mechanism for the Pd(II) compounds catalyzed C=C isomerization in olefins is an oxidative addition of the allylic C-H bond to the metal. Results are presented here to indicate that this reaction catalyzed by electrophilic transition metals involves an electrophilic cleavage of an allylic C-H bond.

7222 **Effect of potassium on the catalyzed reaction of n-hexane over Pt(111) single crystal surfaces.** Zaera, F.; Somorjai, G.A. (Univ. of California, Berkeley). *Journal of Catalysis;* **84**: No. 2, 375-385(Dec 1983). Contract AC03-76SF00098.

The effect of potassium on the n-hexane conversion catalyzed by Pt(111) single crystals has been studied near atmospheric pressures. Reaction activity, selectivity, and self-poisoning with time were studied as a function of potassium coverage of the crystal faces. The activity of the catalyst dropped drastically with as little as 2% potassium atoms on the surface, with no improvement in selectivity or stability. The temperature dependence in the range 55-625 K of the reaction rates was not significantly different from the clean platinum case. The changes in the structure of the carbonaceous deposits formed during the reaction have also been studied. The amount of carbon on the surface after reactions was slightly higher on the platinum surface that was covered with 2% potassium atoms, as compared with the clean platinum case. The amount of bare platinum available for reaction, however, increase by a factor of 2 when theta/sub k/ = 0.3. When potassium was added to the platinum surface, the carbonaceous deposits showed a higher hydrogen content, with a higher activation energy for its desorption, an increase up to 4 kcal/mol more than for the clean platinum case. The inhibition of the dehydrogenation of adsorbed hydrocarbons species in the presence of coadsorbed potassium on the platinum surface explains the changes of reactivity that are reported. 10 figures, 2 tables.

7223 **Organolanthanoid activation of carbon monoxide: single and multiple insertion of CO into t-butyl lanthanoid bonds; x-ray crystallographic identification of a new bonding mode for a bridging enedione diolate ligand formed by formal coupling of four CO molecules.** Evans, W.J.; Wayda, A.L.; Hunter, W.E.; Atwood, J.L. (Univ. of Chicago, IL). *Journal of the Chemical Society, Chemical Communications;* 706-708(1981).

As a result of investigating the reactivity of lanthanoid-carbon $\sigma$-bonded complexes and studying t-butyl complexes, it has been demonstrated that organolanthanoid complexes are capable of reacting with CO and forming isolable Co-insertion products. CO reacts with $(C_5H_5)_2Lu(CMe_3)(OC_4H_8)$ at room temperature to form the isolable dihaptoacyl complex $(C_5H_5)_2Lu(eta^2\text{-}COCMe_3)$, which reacts with additional CO to form the crystallographically characterized bimetallic complex $(C_5H_5)_2LuO_4C_{12}H_{18}Lu(C_5H_5)_2$ in which the two metals are bridged by the enedione diolate ligand 4,5-dihydroxy-2,2,7,7-tetramethyloct-4-ene-3, 6-dionato(2-), which forms 6-

membered metallocyclic rings with each metal atom. 9 references, 2 figures.

## 4004 Electrochemistry

7224 **Deposition and stripping of mercury at gold electrodes in acidic media.** Schadewald, L.A.; Evenson, E.E.; Hussein, W.; Johnson, D.C.; Lingstrom, T.R. (Department of Chemistry and Ames Laboratory - U.S. Department of Energy Iowa State University, Ames, Iowa). *Journal of the Electrochemical Society;* **131**: No. 7, 1583-1587(Jul 1984).

The maximum quantity of bulk Hg(O) which can exist on the surface of a gold electrode in acidic media corresponds to a coverage of /theta/ /SUB Hg/ /SUB O/ = 1. Deposited Hg(O) in excess of this quantity diffuses into the A substrate to form a bulk Au-Hg alloy; however, no alloy is formed until /theta/ /SUB Hg/ /SUB O/ = 1. The potential for the stripping peak o the Au-Hg alloy is positive of the peak potential for the stripping of bulk Hg(O) by ca. 0.4V. The diffusion rate for Hg in the Au-Hg alloy is sufficiently slow so that the alloyed Hg is never totally stripped under the usual condition of cyclic voltammetry. Evidence is also given for the formation of Hg(I) adions during the underpotential deposition process for which n /SUB app/ = 1.6 eq $mol^{-1}$.

7225 **Diffusion-controlled multisweep cyclic voltammetry.** Andricacois, P.C.; Ross, P.N. (Materials and Molecular Research Division, Lawrence Berkeley Laboratory, University of California, Berkeley, California). *Journal of the Electrochemical Society;* **131**: No. 7, 1531-1538(Jul 1984).

An experimental study of diffusion-controlled silver electrodeposition has been carried out in order to investigate the applicability of the model for reversible metal deposition during multisweep cyclic voltammetry. For a stationary planar electrode, excellent agreement between theory and experiment has been obtained for the position of the cathodic current maxima on the potential axis, as well as for the dependence of their magnitude on parameters such as sweep rate, cathodic reversal potential, and number of applied sweeps. Anodic currents measured at the foot of the wave deviated from theoretical predictions as a consequence of the small but uncompensated resistance of the electrolyte. In an effort to predict and therefore control the amount of deposit, integral charges associated with each sweep have been measured and successfully correlated with the parameters of the experiment. It has been found that at millimolar concentrations, deposit thicknesses of the order of up to 20 monolayers can be formed with quantitative control. Experiments with a rotating-disk electrode have demonstrated that a periodic current response is obtained upon multiple sweeping, as predicted by theory.

7226 **Structure of silver and single-crystal surfaces obtained by chemical polishing.** Adzic, R.R.; Hanson, M.E.; Yeager, E.B. (Case Center for Electrochemical Sciences and the Department of Chemistry, Case Western Reserve University, Cleveland, Ohio). *Journal of the Electrochemical Society;* **131**: No. 7, 1730-1731(Jul 1984).

Interest has been increasing in the investigation of electrochemical reactions on single-crystal electrode surfaces. Electrode processes having a pronounced dependence on the particular single-crystal surface include hydrogen adsorption, underpotential deposition of metals, oxidation of organic molecules, and oxygen reduction. Inadequately characterized single-crystal surfaces, however, may lead to misleading results. Atomically flat, well-ordered surfaces are needed in order to obtain meaningful data. Ultrahigh vacuum techniques such as low energy electron diffraction (LEED), Auger electron spectroscopy (AES), and x-ray photoelectron spectroscopy (XPS) can facilitate the characterization of such surfaces and verification of freedom from adsorbed impurities, but these techniques are ex situ. Elaborate systems have been developed for preparing and characterizing single-crystal electrode surfaces in ultrahigh vacuum and then transferring them into the electrochemical environment and vice versa under conditions designed to minimize structural changes and contamination. Experiments with these transfer techniques, however, are very time consuming and impose substantial restraints on the types of electrochemical systems that can be studied because of factors such as the use of completely volatilizable electrolytic solutions and thin-layer cell configurations.

7227 **Reactivity of anthracene in liquid $SbCl_3$-$AlCl_3$-N-(1-butyl)pyridinium chloride mixtures.** Zingg, S.P.; Buchanan, A.C.; Chapman, D.M.; Dworkin, A.S.; Smith, G.P.; Sorlie, M. (Oak Ridge National Laboratory, Chemistry Division, Oak Ridge, Tennessee). *Journal of the Electrochemical Society;* **113**: No. 7, 1602-1608(Jul 1984).

Mixtures of $SbCl_3$ and N-(l-butyl)pyridinium chloride (BPCl) containing 75-87 m/o (mole percent) $SbCl_3$ and $SbCl_3AlCl_3$-BPCl mixtures containing 60 m/o $SbCl_3$ and 16-23 m/o $AlCl_3$ were found to be liquid at 25°C. Dilute solutions of anthracene were stable in ternary mixtures containing 18 m/o $AlCl_3$, but in mixtures containing 22-24 m/o $AlCl_3$, anthracene reacted under the influence of the solvent, which behaved as both oxidant and H-transfer catalyst. The oxidized product was protonated anthracene, which was stable in this melt. The source of protons was provided by hydrogen liberating Scholl condensations combined with the reduction of Sb(III). A part of the hydrogen from Scholl reactions reacted with anthracene to form 9,10-dihydroanthracene. By contrast, a liquid mixture without $SbCl_3$, $AlCl_3$-BPCl (2:1 mole ratio) proved to be a much less active H-transfer catalyst than the $SbCl_3$-rich liquids even though it is a stronger Lewis acid, and it did not induce protonation beyond a trace attributable to protic impurities. The role of impurities in these mixtures was investigated with results that are relevant to earlier investigations of liquid $AlCl_3$-BPCl mixtures. An improved procedure for purifying BPCl is described.

7228 **Electrocatalytic oxidation of As(III).** Cabelka, T.D.; Johnson, D.C. (Department of Chemistry and Ames Laboratory-U.S. Department of Energy, Iowa State University, Ames, Iowa). *Journal of the Electrochemical Society;* **131**: No. 7, 1595-1602(Jul 1984).

Hydrodynamic voltammetry and hydrodynamically modulated voltammetry at a disk electrode, and shielding experiments at a ring-disk electrode, were applied in a study of the electrochemical response of As (III). The adsorption of As(III) occurs at Pt electrodes with partial charge transfer. The adsorption isotherm was determined and a maximum coverage is established for C /SUP b/ /SUB AS/ $> 6 \times 10^{-8}$M. The oxidation of As(III) is electrocatalyzed dramatically by formation of PtOH on the electrode, but is slow for a surface covered by a well developed layer of PtO. The rate-determining step (rds) for As(III) oxidation at the PtO-covered electrode does not involve charge transfer in the region E = 0.9 - 1.2V vs. SCE. The log of the rate constant for the rds measured at 1.1V decreases linearly with the increasing charge equivalent to the surface oxide. The oxidation of As(III) at an oxide-covered electrode is catalyzed by evolution of $O_2$(g). The electrocatalysis is concluded to be the result of X OH generated at the electrode surface.

7229 **Electrochemical properties of the solvent $SbCl_3$-$AlCl_3$-N(1-butyl)pyridinium chloride and electrochemical and spectroelectrochemical studies of arene solutes.** Chapman, D.M.; Mamantov, G.; Petrovic, C.; Smith, G.P.; Sorlie, M. (Oak Ridge National Laboratory, Chemistry Division, Oak Ridge, Tennessee). *Journal of the Electrochemical Society;* **131**: No. 7, 1609-1614(Jul 1984).

Physical and electrochemical properties are reported for $SbCl_3$-$AlCl_3$-N-(1-butyl)pyridinium chloride (BPCl) mixtures that are liquid at ambient temperatures, and studies of the electrogeneration and open-circuit decay of some arene radical cations, both in this medium and in $SbCl_3$-KCl at elevated temperatures, are described. Specific conductivities, densities, and viscosities of the compositions (m/o (mole percent)) 60:19:21 (basic) and 60:21:19 (acidic) $SbCl_3$-$AlCl_3$-BPCl were measured over the temperature range 24°-100°C. For a potentiometric titration between the compositions 60:18:22 and 60:22:18 with $SbCl_3$ fixed at 60 m/o, the potential of the Sb(III)/Sb(0) couple increased by 0.43V at 27°C. Electrochemical studies showed that perylene (Per), 9,10-dimethylanthracene (DMA), and 9,10diphenylanthracene (DPA) can be reversibly oxidized to their radical cations in a 60:19:21 melt, whereas the oxidation of anthracene (Ant) is irreversible. Spectroelectrochemical studies showed that Per radical cations were stable in this melt, those of DPA decayed very slowly, those of DMA decayed somewhat faster, and those of Ant were too transient to be observed optically. Similar degrees of stability were found for these

radical cations in $SbCl_3$ containing 1 M KCl at elevated temperatures, and transient spectra of Ant radical cations were observed in this solvent.

## 4005 Photochemistry

*REFER ALSO TO CITATION(S) 4005007252, 7584*

7230 **Selective perturbation of ligand field excited states in polypyridine ruthenium(II) complexes.** Henderson, L.J. Jr.; Fronczek, F.R.; Cherry, W.R. (Louisiana State Univ., Baton Rouge). *Journal of the American Chemical Society;* **106**: No. 20, 5876-5879(3 Oct 1984).

A new bipyridine-type ligand which allows the selective perturbation of ligand field (LF) excited-state energies is introduced. Any metal-to-ligand charge-transfer (MLCT) excited states occur at nearly the same energy as in the bipyridine complex. The syntheses of the corresponding ruthenium(II) complexes and their photophysical properties are reported. The results clearly support a current model for the excited-state behavior of polypyridine complexes in which the lowest MLCT decays by thermal population of a higher lying LF state. This method of selective LF-state perturbation nicely complements the perturbation of MLCT states achieved by modification of the ligand's reduction potential.

7231 **Photodissociation of $CF_2Br_2$ at 248 nm by the molecular beam method.** Krajnovich, D.; Zhang, Z.; Butler, L.; Lee, Y.T. (Univ. of California, Berkeley). *Journal of Physical Chemistry;* **88**: No. 20, 4561-4566(27 Sep 1984). Contract AC03-76SF00098.

The photochemistry of $CF_2Br_2$ at 248 nm has been studied by the crossed laser-molecular beam technique. The only primary reaction channel observed is atomic bromine elimination: $CF_2Br_2 \rightarrow CF_2Br + Br$. Laboratory angular and time-of-flight distributions of the $CF_2Br$ and Br primary products were measured and used to derive the center-of-mass (CM) product recoil energy and angular distributions for this reaction. The average CM recoil energy of the products is 21.3 kcal/mol. The shape of the CM angular distribution indicates that the transition dipole moment is polarized parallel to the Br-Br direction in $CF_2Br_2$. The molecular bromine elimination reaction, $CF_2Br_2 \rightarrow CF_2 + Br_2$, does not occur to a measurable extent at 248 nm. However, $CF_2$ radicals are produced in abundance under collision-free conditions, due to the efficient secondary photodissociation of some of the $CF_2Br$ primary product.

7232 **Proton-transfer laser: gain spectrum and amplification of spontaneous emission of 3-hydroxyflavone.** Chou, P.; McMorrow, D.; Aartsma, T.J.; Kasha, M. (Florida State Univ., Tallahassee). *Journal of Physical Chemistry;* **88**: No. 20, 4596-4599(27 Sep 1984). Contract AS05-78EV05855.

The efficient generations of amplified spontaneous emission (ASE) in 3-hydroxyflavone in methylcyclohexane and p-dioxane solutions at 293 K is reported. This application of excited-state proton-transfer tautomerization approaches an ideal four-level laser system involving four different molecular electronic species in separate electronic states and constitutes a photoinduced chemical laser. The gain coefficient for the ASE (530 nm) of 3-hydroxyflavone in methylcyclohexane (293 K) is calculated to be 10-15. Under similar conditions in our apparatus, the gain coefficient is observed to be in the range 7-9 for a proprietary coumarin laser dye (Molectron 70371-4 C485) and for rhodamine-6G. The tunable range for 3-hydroxyflavone is observed to be 518-545 nm. The peak laser power is comparable with that observed for the coumarin dye.

7233 **Laser flash photolysis study of photochemical ring opening of 2,3-di-2-naphthyloxiranes and resultant ylide behaviors.** Das, P.K.; Griffin, G.W. (Univ. of Notre Dame, IN). *Journal of Organic Chemistry;* **49**: No. 19, 3452-3457(21 Sep 1984).

Under direct excitation as well as triplet energy-transfer sensitization, cis- and trans-2,3-di-2-naphthyloxiranes from short-lived triplets and carbonyl ylides. From these two oxiranes a major pathway for photogeneration of ylides involves the intermediacy of the triplet. In comparison, the triplet of cis- and trans-2,3-dimethyl-2,3-di-2-naphthyloxiranes are relatively long lived indicating their reluctance to undergo ring opening. In addition to the triplets, the transient phenomena observed upon direct excitation of these two oxiranes indicate the formation of very short-lived species (26-44 ns in benzene) absorbing at long wavelengths (500-600 nm); the latter appear to be the ylides formed from the triplet state. Adverse steric interaction in the planar structures of the ylides from 2,3-dimethyl-2,3,-di-2-naphthyloxiranes is apparently responsible for their short lifetimes and insufficient production under triplet energy-transfer sensitization. Rate constants are given for the quenching of the ylides derived from 2,3-di-2-naphthyloxiranes by dipolarophiles with enhanced reactivity being observed for the electron-deficient dipolarophiles.

7234 **Transient photocurrents in $WSe_2$ and $MoSe_2$ photoanodes.** Prybyla, S.; Parkinson, B.A.; Struve, W.S. (Department of Chemistry, Iowa State University, Ames, Iowa). *Journal of the Electrochemical Society;* **131**: No. 7, 1587-1594(Jul 1984).

Transient photocurrents induced by short laser pulses at $WSe_2$ and $MoSe_2$ photoanodes were studied as a function of electrode morphology, solution redox species, incident laser power and power density, concentration of redox species, and added load resistance. Dual exponential current decay transients were observed in most cases, and a speculative qualitative model is proposed to explain the shape of the transients. The pitfalls associated with such measurements are discussed, and suggestions are made for improved measurement techniques.

7235 **Rotating ring-disk electrode study of competitive photo-oxidation at $\alpha$-$Fe_2O_3$ photoanodes in aqueous solution.** Anderman, M.; Kennedy, J.M. (Department of Chemistry, University of California, Santa Barbara, California). *Journal of the Electrochemical Society;* **131**: No. 7, 1565-1570(Jul 1984).

Competition reactions at $\alpha$-$Fe_2O_3$ photoanodes were studied using the RRDE technique. It was found that iodide, bromide, and chloride ions were photo-oxidized in preference to water in acidic solutions. The competition ratio was measured as a function of halide-ion concentration, halide-ion flux, light intensity, electrode potential, and solution pH. A direct correlation between the disk photocurrent and the competition ratio at a given halide flux was demonstrated. A lack in selectivity for the dark current was also observed.

## 4006 Radiation Chemistry

*REFER ALSO TO CITATION(S) 4006006306*

## 4007 Radiochemistry And Nuclear Chemistry

*REFER ALSO TO CITATION(S) 4007006848, 7476, 7478, 7701, 7827, 7827, 7873*

7236 (FS—83-32-T, pp 77-84) **Problems with the measurement of contaminated reactor components.** Koehler, G.; Schartz, J.; Schueler, H. Nov 1983. (In German). Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland). (CONF-8306168—).

From 17. annual meeting of Fachverband fuer Strahlenschutz e.V.; Aachen, F.R. Germany (8 Jun 1983).

Dismantled reactor components from nuclear facilities represent a considerable value; from an economic point of view, the utilization of such materials is considered imperative as stipulated by section 9 of the Atomic Energy Act and sect. 5 of the Federal Nuisance Control law (BImSchG). The dismantled reactor components are not to be disposed of as radioactive waste, but to be utilized in an unharmful way. The unharmful utilization is 'handling of radiactive materials' according to section 1 of the Radiation Protection Ordinance, Successful decontamination is an indispensable precondition for handling of such materials without the need for approval and/or notification (Sect. 4, Radiation Protection Ordinance). In the past, considerable problems emerged as to the reproducibility of dose rate and contamination measurements. Most of these irregularities occurred because of different measuring methods and the use

of improper and/or different measuring equipment. To minimize these problems, a standardization of measurement is suggested. For this purpose, a measurement regulation was elaborated. The lecturer enters into the problem of giving proof of the dose limits for surface contamination prescribed by law for approval measurements. The work carried out so far is reviewed. Measurement problems occurred in the past are illustrated by individual examples. The difficulties and proposals for possible solutions are put up for discussion.

7237 (FS—83-32-T, pp 209-218) **Experience gained in the decontamination of rooms formerly used for dial painting.** Etzweiler, A.; Lauffenburger, T.; Schaellibaum, H. Nov 1983. (In German). Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland). (CONF-8306168—).

From 17. annual meeting of Fachverband fuer Strahlenschutz e.V.; Aachen, F.R. Germany (8 Jun 1983).

In cases of Ra contamination in rooms formerly used for painting dials, most of the radiation exposure is a result of a concentration of Rn decay products. The decontamination work can be carried out by trained personnel under specialists' instruction and monitoring. To reduce the dose rate and surface contamination, sanitation and waste disposal in accordance with radiation protection requirements is possible, yet costly. Rn sanitation is far less difficult, because Ra depositions are usually outside the buildings within the discharge channel system or in former soakage pits. Should the need arise, measures must also be taken for neighbouring houses.

7238 (FS—83-32-T, pp 219-231) **Cleaning agents for the removal of the surface contamination.** Kunze, S. Nov 1983. (In German). Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland). (CONF-8306168—).

From 17. annual meeting of Fachverband fuer Strahlenschutz e.V.; Aachen, F.R. Germany (8 Jun 1983).

The decontamination cleaning agents, detergents and pastes developed met the 3 requirements as to their good decontaminating action, little frothing and sufficient thermal stability. They were successfully tested in the decontamination of equipment and/or at the KfK Karlsruhe's decontamination landry, and they are being produced under licence and have been used in nuclear facilities and radiochemical laboratories for years.

7239 (FS—83-32-T, pp 232-242) **Control of everyday contamination problems in a hot cell laboratory.** Buch, R. Nov 1983. (In German). Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland). (CONF-8306168—).

From 17. annual meeting of Fachverband fuer Strahlenschutz e.V.; Aachen, F.R. Germany (8 Jun 1983).

For handling unsealed radioactive materials, contamination monitoring and the application of appropriate methods for the prevention of contamination are essential measures to achieve radiation protection safety at the working place and during operation. It is essential to know which are the contamination sources and which circumstances may lead to contamination release and diffusion. Depending on the kind of contamination and the extent of the resulting radiation exposure, suitable easy-to-use measuring equipment is necessary. The lecture shows how contamination release can be limited or prevented, and detected in due time by the use of appropriate measuring instruments, so that contaminations and the ways of decontaminating do not necessarily cause increased dose rates.

7240 (FS—83-32-T, pp 243-253) **Experience gained with the decontamination of the inside of hot cells.** Nievelstein, M. Nov 1983. (In German). Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland). (CONF-8306168—).

From 17. annual meeting of Fachverband fuer Strahlenschutz e.V.; Aachen, F.R. Germany (8 Jun 1983).

For extensive construction work inside of hot cells intensive decontamination has to be carried out in order to keep the burden for personnel due to irradiation and difficult working conditions (for instance breething in protective suits) while working in a cave as low as possible. This is necessary especially if after long periods of hot operation the installations of caves have to be repaired or exchanged. An example of such work in the Juelich Hot Laboratory shows that decontamination close to zero-radiation levels can be carried out for decommissioning.

7241 (FS—83-32-T, pp 255-266) **Radiation protection measures for hot cell sanitation.** Berger, H.U.; Burck, W.; Dilger, H. Nov 1983. (In German). Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland). (CONF-8306168—).

From 17. annual meeting of Fachverband fuer Strahlenschutz e.V.; Aachen, F.R. Germany (8 Jun 1983).

The cell 5 of the Hot Cell Facility of the Kernforschungszentrum Karlsruhe GmbH (KfK) was to be restored and reequipped after 12 years of operation. The decontamination work was first done remotely controlled and afterwards by 38 persons entering the cell, which took about 2 months. The radiation protection methods and personal dosimetry systems are described. At the beginning of the work the $\gamma$-dose rate amounted up to 900 mSv/h. After completion of the remotely controlled decontamination work the $\gamma$-dose rate decreased to 1.5 mSv/h. At that time the $(\alpha+\beta)$ contamination was $10^5$ Bq/cm$^2$. Till the end of the work the removable activity dropped to $10^2$ - $10^3$ Bq/cm$^2$ for $\beta$-radiation, to 0.3 - 30 Bq/cm$^2$ for $\alpha$-radiation and the local dose rate to about 0.03 mSv/h. During the work the accumulated collective doses were listed for breast, hand, head, gonads and foot. In the figure the development with the time of the doses for breast and hand is shown. During restoration work of the cell the accumulated collective whole-body dose amounted to 30 mSv.

7242 (FS—83-32-T, pp 267-279) **Decontamination of cell I at the WAK.** Herrmann, G.; Hoffmann, W.; Wiese, H. Nov 1983. (In German). Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland). (CONF-8306168—).

From 17. annual meeting of Fachverband fuer Strahlenschutz e.V.; Aachen, F.R. Germany (8 Jun 1983).

On May 17, 1980, radioactivity was detected in the heating circuit of the WAK's dissolver. Investigations slowed a slight leakage about the heating jacket allowing 1.9 Ci to escape. The dissolver needed replacing, because repairing was impossible. Before entering the cell, it needed decontaminating. The radiation level had to be reduced to 20-30 mR/h. Decontamination took place in 4 stages: interior decontamination of containers and piping by purging with solvents, remote-control dismantling and desintegration of installations and containers in the cell and removal from the cell, remote-control decontamination of the cell, direct decontamination of the emptied cell.

7243 (FS—83-32-T, pp 281-294) **Generation, prevention, detection and removal of contaminations in a fabrication plant for Pu/U mixed fuel elements.** Hagenberg, W.; Wagner, W. Nov 1983. (In German). Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland). (CONF-8306168—).

From 17. annual meeting of Fachverband fuer Strahlenschutz e.V.; Aachen, F.R. Germany (8 Jun 1983).

Unsealed plutonium and uranium are handled in the fabrication of Pu/U mixed oxide fuel. Owing to the radiotoxicity of plutonium, processing of plutonium and Pu/U mixed oxide takes place in tight cases, i.e. glove boxes, as the first of several barriers. The atmosphere in the working areas and the surface of things outside the glove boxes are subject to permanent activity and contamination. Any surface or air contamination experienced - even if below the limit values as stated in the Radiation Protection Ordinance or in the guideline for physical health control - is registered and reported; contamination sources will be eliminated and the contamination itself removed immediately. Contaminations accrued in one year are investigated with reference to the sources, the distribution of air and surface activity and the effects thereof. Based on this investigation, the network of measurement and administrative measures for the detection of contaminations is illustrated; immediate action to be taken after contamination is exemplified.

7244 (FS—83-32-T, pp 371-391) **Chemical and electrochemical decontamination methods for repair and retrofitting work.** Berthold, H.O. Nov 1983. (In German). Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland). (CONF-8306168—).

From 17. annual meeting of Fachverband fuer Strahlenschutz e.V.; Aachen, F.R. Germany (8 Jun 1983).

A report on experience gained with chemical decontamination of primary loop components in nuclear facilities. In 1976, KWU carried out the decontamination of 8 reactor coolant pumps at the Biblis A and B reactors; it was the first large-scale commercial decontamination in a nuclear power plant in the Federal Republic of Germany. In the meantime, a great number of components and subsystems, such as recuperative heat exchanger, parts of the loop piping, pressurizer heater groups, steam generator primary calotte, main-steam pipes in BWR-type reactors have been chemically decontaminated by KWU. The survey on hand shows decontamination results obtained with KWU's methods. These results are the basis for discussions on the followign issues: - qualification of chemical and electrochemical KWU methods for application in nuclear power plants, - limits of activity reduction by chemical decontamination, - reduction of exposure in manrem by improvements in process technology, - recontamination behaviour of decontaminated surfaces. Experience gained throughout the past years slows that decontamination before inspection, repair and backfitting work considerably helps to reduce radiation exposure of the personnel.

7245 (FS—83-32-T, pp 483-491) **Contamination in the environment as damage occurances.** Koenig, L.A. Nov 1983. (In German). Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland). (CONF-8306168—).

From 17. annual meeting of Fachverband fuer Strahlenschutz e.V.; Aachen, F.R. Germany (8 Jun 1983).

In most of the so-called 'conventional' damage occurrences the material damage is quantifiable in a convenient manner. By contrast, contaminations in the environment both by radioactive and by non-radioactive substances, cannot be evaluated in monetary terms in a generally accepted way. In a case of contamination, possible factors causing costs which must be considered are: the performance of measurements, the decontamination of contaminated persons and objects, the removal of contaminated objects and the evacuation of contaminated areas until clearance after decontamination. The major difference between environmental contaminations and the majority of 'conventional' damage consists in the fact that the specification and lack of specification, respectively, of limit values for admissible contaminations determine decisively the scope of damage. This, in a case of contamination the extent of damage is conditioned by the damage occurrence and the legal regulations and directives issued by the competent authorities. A considerable bandwidth of the extent of damage corresponds to the large margin or discretion available. The problems under consideration are explained by examples and a solution proposed on the basis of the collective dose which might result from contamination and the maximum possible individual dose.

7246 (FS—83-32-T, pp 495-504) **Experience gained with decontamination of luminous paints production plants using tritium.** Etzweiler, A.; Lauffenburger, T.; Schaellibaum, H. Nov 1983. (In German). Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland). (CONF-8306168—).

From 17. annual meeting of Fachverband fuer Strahlenschutz e.V.; Aachen, F.R. Germany (8 Jun 1983).

In Switzerland, about 350 Ci (13 TBq) of tritium are processed annually in each dial painting factory. A considerable part of the HTO reaches the ambient air by radiolysis and exchange processes, which leads to substantial contaminations despite the use of suction systems. 150 persons exposed to radiation in 30 dial painting factories show radiation doses comparable to those of nuclear power plant personnel. The concentration in air to be anticipated from urine measurements in the order of 1.6-1.9 $\mu Ci/m^3$ (59-70 $kBq/m^3$) corresponds to the average measured concentration of 1.5 $\mu Ci/m^3$ (56 $kBq/m^3$). The highest surface contaminations are recorded in the lower part of rooms, which indicates deposition by means of aerosols or solvent vapours. Average floor contaminations are about 2600 $\mu Ci/m^2$ (96.2 $MBq/m^2$).

7247 (INIS-mf—9159) **New method for tritium labelling of neuraminidase from Vibrio cholerae.** Keune, D. (Koeln Univ. (Germany, F.R.). Medizinische Fakultaet). 21 Dec 1981. 83p. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE85780162.

This research work related to the radioactive labelling with tritium of the enzyme neuraminidase from Vibrio cholerae by an easily handled method. The reactive compound N-propionyloxysuccinimide, the ester of propionic acid and N-hydroxysuccinimide, offered a suitable labelling reagent. For comparison purposes an already known method of labelling neuraminidase with tritium by the oxidation of hydroxyl groups of the hydrocarbon chain of the enzymal protein and subsequent reduction of the aldehyde groups formed with tritiated sodium borhydride, was also carried out. The advantages and disadvantages of both methods are described in detail, in particular with regard to yields of radioactivity and the influence on enzyme activity. The fact that only 1 mg enzymal protein was available for each modification of the enzyme molecule posed particular problems and, as a consequence, extensive preliminary experiments had to be carried with another protein (beef serum album) in the same concentration range.

7248 **Raman spectroscopy of neptunyl and plutonyl ions in aqueous solution: hydrolysis of Np(VI) and Pu(VI) and disproportionation of Pu(V).** Madic, C.; Begun, G.M.; Hobart, D.E.; Hahn, R.L. (Oak Ridge National Lab., TN). *Inorganic Chemistry;* **23**: No. 13, 1914-1921(20 Jun 1984). Contract W-7405-ENG-26.

Raman spectra of plutonyl(VI) and neptunyl(VI) ions have been measured as a function of pH in complexing aqueous solutions [$ClO_4^-$ and $Cl^-$ ($\mu$ = 1.0 for Pu(VI)) and $NO_3^-$ ($\mu$ = 1.0 for Np(VI)]. The symmetrical stretching vibration, nu/sub 1/, was found, for Pu(VI), to consist of four bands at 833, 817, 826, and 805 $cm^{-1}$ and, for Np(VI), of two bands at 854 and 834 $cm^{-1}$. These bands have been identified as vibrational transitions for $PuO_2^{2+}$ (833 $cm^{-1}$), $(PuO_2)_2(OH)_2^{2+}$ (817 $cm^{-1}$), $(PuO_2)_4(OH)_7^+$ (826, 805 $cm^{-1}$), $NpO_2^{2+}$ (854 $cm^{-1}$), and $(NpO_2)_2(OH_2)^{2+}$ (834 $cm^{-1}$). For high values of pH (13-14), a new Pu(VI) band was found at 794 $cm^{-1}$, which exhibited a moderate resonance Raman effect. A plutonyl(V) solution, $PuO_2^+$, was prepared by electrochemical reduction of $PuO_2^{2+}$. The Raman spectrum of Pu(V) showed a band at 748 $cm^{-1}$, assigned to the symmetrical stretching vibration, $nu_1$, of $PuO_2^+$. Evidence for the disproportionation of $PuO_2^+$ as a function of time was obtained from Raman spectrometry by observing the decrease of the intensity of the 748-$cm^{-1}$ $PuO_2^+$ band and the increase of bands located at 833 and 817 $cm^{-1}$ belonging to $PuO_2^{2+}$ and $(PuO_2)_2(OH)_2^{2+}$, respectively. 41 references, 13 figures, 3 tables.

## 4008 Combustion, Pyrolysis, And High-temperature Chemistry

7249 **(DOE/ER/04426—7) Kinetics of elementary atom and radical reactions. Progress report.** Gordon, R.J. (Chicago Univ., IL (USA)). 10 Jul 1984. Contract AC02-77ER04426. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003319.

During the past fiscal year, work was performed on three projects: kinetics of the combustion reaction $O(^3P) + H_2$, energy storage in highly excited polyatomic molecules, and the kinetics of $NH(^3\Sigma^-)$ reactions.

7250 **(DOE/ER/04759—6) Laser schlieren, shock tube studies of high temperature hydrocarbon pyrolysis rates. Progress report, June 1, 1982-December 1, 1984.** Kiefer, J.H. (Illinois Univ., Chicago (USA). Dept. of Chemical Engineering). Dec 1984. Contract AC02-78ER04759. 23p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003314.

Progress during the past 2-1/2 years is reflected in the completion and either publication or submission of several projects using the laser-schlieren shock-tube technique; the pyrolysis of propane, ethylene, benzene, ethane, and 1,3-butadiene. In addition the new technique of laser flash absorption has been put into full operation and important results on 1,3-butadiene, showing that dissociation must be to two vinyl radicals as originally proposed, have been

derived. Laser-schlieren data on toluene and ethylbenzene have also been obtained, and partially analyzed. 6 figures.

7251 **Effects of transient combustion phenomenon on molecular beam sampling.** Lucas, D.; Peterson, R.; Hurlbut, F.C.; Oppenheim, A.K. (Univ. of California, Berkeley). *Journal of Physical Chemistry;* **88**: No. 20, 4548-4552(27 Sep 1984). Contract AC03-76SF00098.

The measurement of transient events with a molecular beam mass spectrometer is often difficult due to the rapid and large changes in temperature, pressure, and chemical composition encountered in a reacting mixture during combustion processes. Studies of how results arising from varying the source parameters under steady-state conditions can be used in interpreting data from a flash-initiated combustion mixture are reported. Time of arrival curves from heated argon beams are measured and compared to curves calculated with an algorithm based on a physical modeling of the time-of-flight process. Results indicate that the source temperature determines the peak arrival time, and that the beam half-width is essentially constant during a typical combustion event. These results are then applied to a reacting $H_2/O_2/NO_2/Ar$ system.

7252 **Molecular beam overrun in sampling transient combustion processes.** Peterson, R.; Lucas, D.; Hurlbut, F.C.; Oppenheim, A.K. (Univ. of California, Berkeley). *Journal of Physical Chemistry;* **88**: No. 20, 4746-4749(27 Sep 1984). Contract AC03-76SF00098.

Effects of combustion-generated source temperature variations on direct sampling in a molecular beam mass spectrometer are examined. The problem of particular concern is the influence of beam overrun on the distribution of molecules arriving at the detector. The overrun is due to the fact that the hotter, and thus faster, constituents of the molecular beam are formed later than its colder, and thus slower, portions. Photolysis of $NO_2$ in Ar and flash-ignited mixtures of $Ar/CH_4/O_2/NO_2$ using a chopped molecular beam time-of-flight technique yields time-resolved temperature measurements, while concomitant numerical analysis predicts quite accurately the observed beam overrun. Analysis of continuous sampling in representative transient combustion processes indicates that the molecular beam mass spectrometer is capable of measuring meaningful time-resolved concentration profiles.

7253 **Defining the turbulent burning velocity in premixed V-shaped turbulent flames.** Cheng, R.K.; Ng, T.T. (California Univ., Berkeley). *Combustion and Flame;* **57**: 155-167(Aug 1984). Contract AC03-76SF00098.

Turbulent burning velocity St is determined for six premixed V-shaped turbulent flames. In addition to defining St with respect to the conventional flame surface, a definition based on an effective flame orientation is proposed. The results based on the flame surface increase significantly with distance from the flame stabilizer. In general, they compare quite poorly with experimental correlation obtained by others. However, the results based on the effective flame orientation are more consistent and provide better comparison. These results indicate that the flame surface method is not a consistent method for deducing the turbulent burning velocity in this flame configuration. 18 references.

7254 **Effects of molecular structure on soot formation. I. Soot thresholds in premixed flames.** Olson, D.B.; Pickens, J.C. (Aerochem Research Labs., Inc., Princeton, NJ). *Combustion and Flame;* **57**: 199-208(Aug 1984). Contract AC22-80PC30304.

Soot thresholds have been measured in atmospheric pressure, laminar premixed flames of 55 pure hydrocarbons. Soot threshold data as a function of fuel structure parameters are presented in four forms: threshold soot indices, TSIs equivalence ratios assuming combustion to CO2 and H2O, phi sub c equivalence ratios assuming combustion to CO and H2O, phi sub c and carbon to oxygen atom ratios (C/O)c. The relative TSI scale allows comparison with previous measurements and removes apparatus-dependent variations in the data. Data were obtained for more than 40 previously unstudied fuels, including 15 alkanes, 14 alkenes, 7 alkynes, and 15 aromatics. Comparison with similar data in the literature gave good agreement. Suggested TSI values are given for all fuels which have been reported. 15 references.

# 42 ENGINEERING

## 4201 General Engineering

7255 **(ORNL—6054) Simulation of the electrochemical machining process.** Gray, L.J.; Serbin, C.A.; Dietrich, W.C. (Oak Ridge National Lab., TN (USA)). Nov 1984. Contract AC05-84OR21400. 51p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85003797.

An algorithm for simulating a two-dimensional electrochemical machining process is presented. A major part of the calculation, the solution of Laplace's equation, is accomplished by a boundary element method based upon Green's formula. Polarization, in the form of the Tafel equation, is included in the model. The computer program is discussed in detail.

7256 **(UCRL—50016-84-2) Mechanical Engineering Department technical abstracts.** (Lawrence Livermore National Lab., CA (USA)). 1 Jul 1984. Contract W-7405-ENG-48. 32p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85003881.

The Mechanical Engineering Department publishes abstracts twice a year to inform readers of the broad range of technical activities in the Department, and to promote an exchange of ideas. Details of the work covered by an abstract may be obtained by contacting the author(s). General information about the current role and activities of each of the Department's seven divisions precedes the technical abstracts. Further information about a division's work may be obtained from the division leader, whose name is given at the end of each divisional summary. The Department's seven divisions are as follows: Nuclear Test Engineering Division, Nuclear Explosives Engineering Division, Weapons Engineering Division, Energy Systems Engineering Division, Engineering Sciences Division, Magnetic Fusion Engineering Division and Materials Fabrication Division.

## 4202 Facilities And Equipment

*REFER ALSO TO CITATION(S) 4202006459, 6491, 6497, 6501, 7358, 7918*

7257 **(CONF-840705—5) Stability of superconducting composites in a magnetic field.** Gray, K.E. (Argonne National Lab., IL (USA)). Sep 1984. Contract W-31-109-ENG-38. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85002731.

From 10. international conference on cryogenic engineering; Espoo, Finland (31 Jul 1984).

The recent calculation of the stability criterion for superconducting films in zero field is extended to finite fields by including flux flow. The results of this one-dimensional (1D) model are in excellent agreement with quench experiments on multifilamentary conductors wound in a magnet. This 1D model works well because the thermal conductivity between windings is small, but including it in the model is nevertheless important to the agreement.

7258 **(CONF-8409108—6) Ferrite permanent magnet ac motor: a technical and economical assessment.** Richter, E.; Miller, T.J.E.; Neumann, T.W.; Hudson, T.L. (Oak Ridge National Lab., TN (USA); General Electric Co., Schenectady, NY (USA)). 1984. Contract AC05-84OR21400. 7p. NTIS, PC A02. File Number DE85002480.

From IEEE-IAS meeting; Chicago, IL, USA (30 Sep 1984).

The work described in this paper was sponsored by the Division of Electric Energy Systems (EES) of the US Department of Energy (DOE) through a subcontract with the Power Systems Technology Program at the Oak Ridge National Laboratory (ORNL). The paper summarizes the design and analysis study for the conceptual design of an economical high efficiency ac motor based on permanent magnets. Material considerations, design tradeoff options as well as transient and steady state performance under normal and abnormal conditions have been considered. The baseline comparison is the high efficiency induction motor. The permanent magnet (PM) motor must fit into the same frame size and sur-

pass the induction motor on a life cost basis that includes 2.5 years of operation at a 50% duty cycle. The study results indicate that a motor with ferrite magnets meets the objectives of the program in ratings of up to 25 hp. A 7.5-hp motor design is carried through the conceptual design stage.

7259 **(DOE/ER/45026—2) Improvement in high magnetic field properties of vanadium-gallium superconductors by enhancement of spin-orbit scattering. Final report.** Tedrow, P.M.; Meservey, R. (Massachusetts Inst. of Tech., Cambridge (USA). Francis Bitter National Magnet Lab.). 31 Aug 1984. Contract AC02-83ER45026. 3p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85002893.

The aim of this study was to improve the high-magnetic field characteristics of the practical superconductor vanadium-gallium by enhancing the spin-orbit scattering rate in this material. To this end, thin films of V-Ga of various compositions were made by electron beam codeposition. Third elements with high atomic number Z were added to these films during deposition. High-Z impurities are expected to be most effective in increasing the spin-orbit scattering rate. The elements added were Nb, Ta, Sn, Pt and Pb. These impurities were added at a level of about one percent.

7260 **(DPST—84-736) Robotics at Savannah River site: activity report.** Byrd, J.S. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Sep 1984. Contract AC09-76SR00001. 35p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85003657.

The objectives of the Robotics Technology Group at the Savannah River Laboratory are to employ modern industrial robots and to develop unique automation and robotic systems to enhance process operations at the Savannah River site (SRP and SRL). The incentives are to improve safety, reduce personnel radiation exposure, improve product quality and productivity, and to reduce operating costs. During the past year robotic systems have been installed to fill chemical dilution vials in a SRP laboratory at 772-F and remove radioactive waste materials in the SRL Californium Production Facility at 773-A. A robotic system to lubricate an extrusion press has been developed and demonstrated in the SRL robotics laboratory and is scheduled for installation at the 321-M fuel fabrication area. A mobile robot was employed by SRP for a radiation monitoring task at a waste tank top in H-Area. Several other robots are installed in the SRL robotics laboratories and application development programs are underway. The status of these applications is presented in this report.

7261 **(Juel—1911) Service life investigations of ball bearings at 120°C in a helium atmosphere.** Haas, H. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Zentralabteilung Allgemeine Technologie). Apr 1984. 105p. (In German). NTIS (US Sales Only), PC A06/MF A01. File Number DE84752303.

The generally known rules for the layout of ball bearings do not yield accurate results in the case the bearings run in an helium atmosphere contaminated with impurities in the range of microbars. Therefore the layout of bearings put into action in helium has to be supported by tests carried out in a similar environment and for similar loads. With the aim to support the selection of lubricants and the design of the bearings in regard to the economical point of view, the basic principles of tribology in helium have been compiled and forty ball bearings have been tested at 90°C and 120°C in helium. The applied loads comply with the usual values in machine construction. The tests show as result that ball bearings suitable for the different fields of applications in helium can be produced by simply exchanging the cages of standardized bearings. Reliable $10^7$ revolutions have been obtained for different materials, also for cages made out of soft metals such as lead bronze, suitable in a radiation environment. In addition lubricants have been tested in order to find out the limits of suitability.

7262 (KEK—82-3, pp 126-133) **Application of cryopump to a surface analysis system.** Akaishi, Kenya; Onodera, Jun-ichi; Sagara, Akio; Kamata, Koji (Nagoya Univ. (Japan). Inst. of Plasma Physics). Jun 1982. (In Japanese). NTIS (US Sales Only), PC A09/MF A01. File Number TI85780074. (CONF-8203186—).

From 4. meeting on ultra high vacuum techniques for accelerators and storage rings; Oho, Ibaraki, Japan (12 Mar 1982).

A large ultrahigh vacuum system was designed. A cryopump was considered as the pumping apparatus of the vacuum system. A turbomolecular pump was used as a fore pump. The obtained vacuum of the system after the baking at 200 degree C was 1 x $10^{-10}$ Torr. Somewhat high partial pressure of steam was observed in the residual gas spectrum. It is necessary that the rare gas introduction system is made so as to enable the control of impurity gas. The periodic variation of the partial gas pressure of He and $H_2$ gases was observed. The variation of He gas pressure was caused by the following reason. Since the cryopanel is cooled to 10 degree K, the He gas adsorbed by activated charcoal is adsorbed or desorbed according to the variation of temperature. The variation of $H_2$ gas pressure was also seen. The ion scattering spectrum of a molybdenum single crystal was obtained at the vacuum of 1 x $10^{-10}$ Torr.

7263 **(LA-UR—84-3173) Statistical theory of fragmentation processes.** Dienes, J.K. (Los Alamos National Lab., NM (USA)). 1984. Contract W-7405-ENG-36. 35p. (CONF-8411109—1). NTIS, PC A03/MF A01; GPO Dep. File Number DE85002206.

From Workshop on enelastic deformation and failure modes; Evanston, IL, USA (18 Nov 1984).

The goal of the work reviewed here is a theory of material behavior accounting for the average deformation that results from the opening, shear, growth and coalescence of an ensemble of microcracks. A concomitant is the calculation of permeability from crack structure. The first part of this paper summarizes previous developments. In particular, the initial work on this problem made use of a linear Liouville equation to characterize the change in crack distribution resulting from crack growth and coalescence. Straightforward analytic solutions to this equation were possible because the mean free path of cracks was assumed constant. Though this assumption is useful for the early stages of crack growth, increasing crack size reduces the mean free path in the later stages of fragmentation. This problem is addressed in the second part of this paper. The governing (nonlinear) Liouville equation is derived therein, and it is shown that it can be reduced to an ordinary differential equation of third order involving only a single parameter, $\beta$. This equation has now been solved numerically to determine the limiting value of the mean free path as a function of $\beta$, and the results are presented in graphical form. In the third part of this paper prospects for further developments are briefly discussed.

7264 **(ORNL/CSD/TM—221) Validation of the Monte Carlo Criticality Program KENO V.a for highly-enriched uranium systems.** Knight, J.R. (Oak Ridge National Lab., TN (USA)). Nov 1984. Contract AC05-84OR21400. 87p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85004325.

A series of calculations based on critical experiments have been performed using the KENO V.a Monte Carlo Criticality Program for the purpose of validating KENO V.a for use in evaluating Y-12 Plant criticality problems. The experiments were reflected and unreflected systems of single units and arrays containing highly enriched uranium metal or uranium compounds. Various geometrical shapes were used in the experiments. The SCALE control module CSAS25 with the 27-group ENDF/B-4 cross-section library was used to perform the calculations. Some of the experiments were also calculated using the 16-group Hansen-Roach Library. Results are presented in a series of tables and discussed. Results show that the criteria established for the safe application of the KENO IV program may also be used for KENO V.a results.

7265 **(UCID—20168) Servo-controlled biaxial test system.** Thayer, W.L. (Lawrence Livermore National Lab., CA (USA)). 11 Feb 1983. Contract W-7405-ENG-48. 10p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85001653.

A large test program requiring axial torsion tests was submitted to the Materials Test and Evaluation Section of the Engineering Sciences Division by the Chemistry Department. The objective of these tests was to provide insight with regard to the fundamental aspects of plastic deformation and hardening of nickel. Thes tests will also provide the constants necessary for a constitutive equation

for use in weld modeling. The weld models will attempt to predict residual stresses in nickel welds. The test program consisted of approximately 70 specimens of high purity nickel to be tested in torsion over a large temperature range (RT - 900°C) at a strain rate of about 1 x $10^{-4}$ in./in./sec to steady state at each temperature. After having attained steady state, the strain-rate-reversal (Bauschinger test) and incremental-changes-in-strain-rate tests ($10^{-4}$ to 2 x $10^{-3}$ in./in./sec) at constant structure will be conducted. Additional tests such as transient backstress and yield surface distortion (using multi-axial stress states) will be carried out. This particular request required a biaxial test machine capable of more than 360° rotation in torsion. Temperature capabilities, atmosphere control, and a control system were also needed whereby the machine could be operated in torsion using strain control. Such a machine did not commercially exist so it was necessary to build one. The basic unit chosen was a 20K Servo-Electric Hydraulic Test Machine to which we added a simple anti-rotation fixture for the ram. This constituted the axial portion of the system.

7266 **(UCID—20215) Phenomenology of microwave coupling. Part I.** King, R.J.; Breakall, J.K.; Hudson, H.G.; Morrison, J.J.; McGevna, V.G.; Kunz, K.S.; Ludwigsen, A.P.; Gnade, D.K. (Lawrence Livermore National Lab., CA (USA)). Nov 1984. Contract W-7405-ENG-48. 91p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85003097.

Recent advances in the development of high power microwave sources have increased the potential for future deployment of microwave weapons. A key ingredient in being able to predict the vulnerability of military systems to such threats involves understanding the phenomenology of how electromagnetic energy couples into cavity-like objects, or the so-called back-door coupling. A similar but much longer standing problem is that of nuclear electromagnetic pulses (EMP) in which the frequencies extend up to several hundreds of MHz. However, compared to EMP coupling, microwave coupling (from 1 GHz to above 40 GHz) is distinctively different because the wavelength is comparable to the size of the ports of entry (apertures, seams, cracks, protruding connectors, etc.). These ports of entry and the interior configuration of a vulnerable system are no longer below cutoff, and can permit significant penetration of the microwave energy into susceptible electronic systems. In fact, these coupling paths can be highly resonant at certain microwave frequencies, making the shielding against microwave threats difficult. This report summarizes the initial efforts at Lawrence Livermore National Laboratory to study the phenomenology of back door coupling at the low microwave frequencies (up to 2.5 GHz). These studies were limited to 2.5 GHz because the limitations of the Electromagnetic Transient Range Facility.

7267 **(UCRL—90716) Requirements of quantitative NDE in developing fracture control plans.** Streit, R.D. (Lawrence Livermore National Lab., CA (USA)). 1 Nov 1984. Contract W-7405-ENG-48. 11p. (CONF-840738—12). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003147.

From Progress in quantitative NDE; San Diego, CA, USA (8 Jul 1984).

The goal of quantitative nondestructive evaluation, QNDE, is to quantify the results of an inspection: e.g., flaw size, porosity, inclusions, etc., such that results can be used in an engineering design evaluation. In this respect, it is important for the NDE community to closely interface with the design and materials engineers to establish the important quantifiable factors which can be readily used. One specific interaction is that of the fracture mechanics analysis and QNDE flaw size characterization. In this paper, we address the needs of the flaw size characterization in fracture control planning. Three factors; i.e., flaw size, flaw shape, and the probability of detection are discussed relative to linear-elastic fracture mechanics (LEFM). This paper is divided into three section; basics of LEFM, concepts of fracture control planning, and the requirements for flaw characterization. Special topics in fracture mechanics, such as elastic-plastic fracture or fracture of brittle materials (e.g., Weibul statistics) are not dealt with specifically, however, the same variables - flaw size, shape and probability of detection are equally important under these constraints as with LEFM.

7268 **Magnetic refrigeration apparatus and method.** Barclay, J.A.; Overton, W.C.; Stewart, W.F. Jr. (to Dept. of Energy). US Patent 4,459,811. 17 Jul 1984. Filed date 28 Mar 1983. vp.

PAT-APPL-479596.

The disclosure relates to refrigeration through magnetizing and demagnitizing a body by rotating it within a magnetic field. Internal and external heat exchange fluids and in one embodiment, a regenerator, are used.

7269 **Applications and fabrication processes of superconducting composite materials.** Gregory, E. (Oxford Airco, Carteret, NJ). *Journal of Metals;* **36**: No. 6, 30-34(Jun 1984).

This paper discusses the most recent applications and manufacturing considerations in the field of superconductivity. The constantly changing requirements of a growing number of users encourage development in fabrication and inspection techniques. For the first time, superconductors are being used commercially in large numbers and superconducting magnets are no longer just laboratory size. Although current demand for these conductors represents relatively small quantities of material, advances in the production of high-quality composites may accelerate technological growth into several new markets. Three large-scale application areas for superconductors are discussed: accelerator magnets for high-energy physics research, magnetic confinement for thermonuclear fusion, and magnetic resonance imaging for health care. Each application described is accompanied by a brief description of the conductors used and fabrication processes employed to make them.

7270 **Assessing the effect of stylus tip radius and flight on surface topography measurements.** McCool, J.I. (SKF Industries, Inc., King of Prussia, PA). *American Society of Mechanical Engineers, [Paper];* No. 83-Lub-19, 1-8(1984). (CONF-8310298—).

From ASLE and ASME lubrication conference; Hartford, CT, USA (18 Oct 1983).

The mean square height, slope, and curvature are characteristics of roughness microgeometry that govern the performance of real surfaces in elastic contact. The values of these quantities deduced from stylus profile traces are distorted by the nonlinear filtering effect of the finite stylus tip and by the failure, at high enough tracing speeds of the stylus to maintain contact with the profile being traced. The development of a simulation model for assessing the magnitude of this distortion as well as the effect of record length and sampling frequency with tracing profiles that are realizations of a radom process having a specified spectrum are described. Illustrative parametric runs of the model are discussed.

7271 **Structural design with brittle materials.** Evans, A.G. (Univ. of California, Berkeley). pp 475-502 of Ceramics for high-performance applications. III. Reliability. Lenoe, E.M.; Katz, R.N. (eds.). New York, NY, USA; Plenum Publishing Corporation (1983). Contract W-7405-ENG-48.

Structural design with brittle materials requires that the stress level in the component correspond to a material survival probability that exceeds the minimum survival probability permitted in that application. This can be achieved by developing failure models that fully account for the probability of fracture from defects within the material (including considerations of fracture statistics, fracture mechanics and stress analysis) coupled with non-destructive techniques that determine the size of the large extreme of critical defects. Approaches for obtaining the requisite information are described in this paper. The results provide implications for the microstructural design of failure-resistant brittle materials by reducing the size of deleterious defects and enhancing the fracture toughness.

## 4203 Lasers

*REFER ALSO TO CITATION(S) 4203007232, 8067*

7272 **(DOE/ER/06484—T1) Use of an extended ion source for short wavelength lasing.** Elton, R.C. (Naval Research Lab., Washington, DC (USA). Optical Sciences Div.). 30 May 1980. Contract AI01-78ER06484. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85002896.

The purpose of this research is to advance the frontier of short wavelength laser development towards shorter wavelengths with efficiency, through research into the mechanisms of achieving population inversion and (cavity) gain in highly-ionized plasma media. The results are of vital importance for developing a new tool for materials characterization and alteration, for energy efficiency, as well as for defense needs. Ionized atoms of light elements, such as carbon, are generated at a surface by heating with a focused high power laser. The plasma expands either freely or in channeled motion to fill a cavity region. Population inversions are usually generated by electron capture into excited states of cavities. Density and gain are scaled upward and shorter wavelengths are sought. At high gains, the cavity is removed for single-pass amplification in a column for use in the extreme ultraviolet spectral region.

7273 **(LA-UR—84-2749) Numerical simulation of turbulent reacting flows.** Cloutman, L.D. (Los Alamos National Lab., NM (USA)). 1984. Contract W-7405-ENG-36. 9p. (CONF-850116—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE84016777.

From International conference on advances in numerical methods in engineering: theory and applications; Swansea, UK (7 Jan 1985).

A multidimensional, transient computational fluid dynamics algorithm has been developed for simulation of reacting flows in automotive engines. We describe the basic features of the method and present several numerical solutions obtained with it.

7274 **(UCID—20119) Modern solid state laser materials.** Krupke, W.F. (Lawrence Livermore National Lab., CA (USA)). 20 Jun 1984. Contract W-7405-ENG-48. 36p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85003665.

This document contains visual aids used in an invited talk entitled Modern Solid State Laser Materials, presented at the Conference on Lasers and Electro-Optics (CLEO) held in Anaheim, California, on June 20, 1984. Interest at LLNL in solid state lasers focuses on evaluating the potential of solid state laser media for high average power applications, including inertial fusion power production. This talk identifies the relevant bulk material parameters characterizing average power capacity and uses chromium and neodymium co-doped gadolinium scandium gallium garnet (Nd:Cr:GSGG) as an example of a laser material with improved laser properties relative to Nd:YAG (plausible large-scale growth, more efficient spectral coupling to xenon flashlamp radiation, reduced stimulated emission cross section, adequate thermal shock and optical damage threshold parameters, etc.). Recently measured spectroscopic, kinetic, and thermo-mechanical properties of Nd:Cr:GSGG are given.

7275 **Electrically charged targets.** Goodman, R.K.; Hunt, A.L. (to Dept. of Energy). US Patent 4,455,276. 19 Jun 1984. Filed date 19 Sep 1978. vp.

PAT-APPL-943903.

Electrically chargeable laser targets and method for forming such charged targets in order to improve their guidance along a predetermined desired trajectory. This is accomplished by the incorporation of a small amount of an additive to the target material which will increase the electrical conductivity thereof, and thereby enhance the charge placed upon the target material for guidance thereof by electrostatic or magnetic steering mechanisms, without adversely affecting the target when illuminated by laser energy.

## 4204 Heat Transfer And Fluid Flow

*REFER ALSO TO CITATION(S) 4204006342, 6810*

7276 **(BMI—1984-034) RALOC Mod 1/81: Program description of RALOC version by the structural heat model HECU.** Pham, V.T. (Bundesministerium des Innern, Bonn (Germany, F.R.); Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). Apr 1984. 64p. (In German). (GRS-A—885). NTIS (US Sales Only), PC A04/MF A01. File Number DE84752326.

In the version RALOC-Mod 1/81 an expanded heat transfer model and structure heat model is included. This feature allows for a realistic simulation of the thermodynamic and fluiddynamic characteristics of the containment atmosphere. Steel and concrete substructures with a plain or rotational symmetry can be represented. The treat transfer calculations for the structures are problem oriented, taking into account, the time- and space dependencies. The influence of the heat transfer on the gas transport (in particular convection) in the reactor vessel is demonstrated by the numerical calculations. In contrast to the calculations without a simulation of the heat storage effects of the container structures showing a widely homogenious hydrogen distribution, the results on the basis of the HECU-model give an inhomogenious distribution during the first 8 to 12 days. However these results are only examples for the application of the RALOC-Mod 1/81 -code, which have not been intended to contribute to the discussion of hydrogen distributions in a PWR-type reactor.

7277 **(DOE/ER/10867—T1) Momentum and heat transfers in a complex, but well-defined turbulent fluid flow. Final report.** (Stanford Univ., CA (USA). Dept. of Civil Engineering). 12 Nov 1984. Contract AT03-81ER10867. 35p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85002857.

Turbulent, mixed convection, recirculating flows are relevant to a number of energy applications. Motivated by an apparent deficiency in our understanding of such flows and how to predict them accurately, we began in March 1981 a numerical and experimental study of the lid-driven flow in a rectangular cavity. This letter report is the final report under the subject contract and covers the period from March 1981 through September 1984.

7278 (DOE/ER/10867—T1, pp 7p, Paper 1) **Flow visualization and heat flux measurements in a three-dimensional recirculating flow.** Koseff, J.R.; Rhee, H.; Street, R.L. 12 Nov 1984. NTIS, PC A03/MF A01. File Number TI85002857.

In Momentum and heat transfers in a complex, but well-defined turbulent fluid flow. Final report.

Experiments have been conducted in a three-dimensional lid-driven cavity flow to study the effect of longitudinal Taylor-Goertler-like vortices on heat transfer. Flow visualization confirms the existence and shows the form of the vortices. Heat flux measurements made at the bottom of the cavity are correlated to fluid velocity measurements to demonstrate that heat transfer is locally enhanced by the presence of the vortices. Further measurements are underway to quantify these results.

7279 (DOE/ER/10867—T1, pp 7p, Paper 2) **Mixing in a stratified recirculating flow.** Koseff, J.R.; Rhee, H.; Street, R.L.; Asce, M. 12 Nov 1984. NTIS, PC A03/MF A01. File Number TI85002857.

In Momentum and heat transfers in a complex, but well-defined turbulent fluid flow. Final report.

Experiments were conducted to study the mixing processes and circulation patterns in a stratified, lid-driven cavity flow. This flow is different from those reported in the literature in three ways, viz., recirculation is a dominant feature, temperature is used as the stratification device, and the upper and lower boundaries are held at different constant tempratures. For the geometric configuration used entrainment rate E is proportional to $Ri^{-7/8}$. Taylor-Goertler-like vortices above the thermocline are significant contributors to the mixing process. In addition, the number of circulation cells ex-

pected in this stratified flow can be estimated by use of the bulk Richardson number Ri/sub b/.

7280 **(DOE/ER/10867—T1, pp 19p, Paper 3) Three-dimensional lid-driven cavity flow: experiment and simulation.** Koseff, J.R.; Street, R.L.; Gresho, P.M.; Upson, C.D.; Humphrey, J.A.C.; To, W.M. (Stanford Univ., CA; Lawrence Livermore National Lab., CA; Univ. of California, Berkeley). 12 Nov 1984. NTIS, PC A03/MF A01. File Number TI85002857.

In Momentum and heat transfers in a complex, but well-defined turbulent fluid flow. Final report.

A facility has been constructed to study shear-driven, recirculating flow, namely, a three-dimensional lid-driven cavity flow. In the extant case, the cavity depth-to-width aspect ratio is 1:1, while the span-to-width aspect ratio is 3:1. A description of the circulation cell structure obtained by flow visualization is given for two Reynolds numbers with and without temperature-induced density stratification. The experimental results are compared to simulations by two different numerical codes, one employing finite differences and one employing finite elements. The numerical codes reproduce the overall behavior observed in the experiments, but fail to simulate observed longitudinal vortices. There are some significant differences also between the numerical results, highlighting the effects of using the HYBRID (upwind/central) differencing scheme in one code.

7281 **(KFK—3348) STATI-4, a one-dimensional non-steady heat transport program (FORTRAN) for cylindrical geometry.** Wagner, K. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Hauptabteilung Ingenieurtechnik; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Nukleare Sicherheit). May 1984. 172p. (In German). NTIS (US Sales Only), PC A08/MF A01. File Number DE84752294.

Due to the explicit solution method within the heat conduction part the present heat transport routine is capable of calculating temperature as a function of time in radially symmetric, cylindrical geometries with an arbitrary number of gas gaps, gaps with convection, or radiation shields, without requiring substitute heat transfer coefficients. This is an advantage over the implicit solution method, but requires longer computation times. At present no routine has been implemented in STATI-4 which calculates contact between solids. If a gap is nearly closed, a space of 1 μm between adjacent meshes is imposed by the routine. In almost all cases this results in an error of only a few degrees K. Apart from this, the routine is very versatile and has been thoroughly tested against extreme examples. Data input is easy. Since the routine was developed initially as part of a program for verifying the fuel rod behavior of nuclear fuel rods and their electrical simulators, the associated library of material properties includes only materials which were needed for that particular application. However, the library can be easily extended, to include other materials properties.

7282 **(KFK—3743) Computer programs for evaluation of turbulence characteristics from hot-wire measurements.** Vosahlo, L. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Neutronenphysik und Reaktortechnik). Jun 1984. 139p. NTIS (US Sales Only), PC A07/MF A01. File Number DE84752325.

This report describes the set of the computer programs for evaluation of the turbulent flow characteristics from hot-wire experimental data. Three different methods and, in addition, some variants are solved in these programs. This enables a comparison of the results obtained by these methods and the analysis of the influence of individual calculation parameters and calibration coefficients on the evaluated results. The results are printed in lucid numerical tables and written into files for further processing into graphs by plotting routines.

7283 **(NP—5770091) Heat transfer with superimposed free and forced convection in annular spaces.** Badr El-Din Sakr. (Siegen Univ. (Gesamthochschule) (Germany, F.R.). Fachbereich 11 - Maschinentechnik 1). 28 Sep 1983. 159p. (In German). NTIS (US Sales Only), PC A08/MF A01. File Number DE85770091.

The complete equations of motion and energy equation for two-dimensional laminar annular flow were simultaneously solved numerically by means of a differential process. The effect of free convection can be expressed by the Boussinesq approximation. The dependence on temperature of the viscosity is taken into account. The heat transfer coefficients obtained by calculation show good agreement with measured values.

7284 **(PB—84-233865) Post-dryout heat transfer for steam/water flowing in vertical tubes at high pressure.** Scruton, B.; Chojnowski, B. (Central Electricity Generating Board, Southampton (UK). Technology Planning and Research Div.). 1982. 14p. (TL—397). NTIS, PC E03/MF E03.

Post-dryout heat transfer measurements for steam/water flowing in a vertical uniformly heated tube with internal diameter 19mm have been obtained in tests carried out on the MEL Boiling Water Rig in a program of work to study critical heat flux. Test conditions covered pressures 140 to 180 bars and mass flux 400 - 2250 kg/(sq m). The ranges of heat flux and steam quality over which heat transfer data were obtained lay within the limits 0.2 to 0.7 MW/sq m and 0.2 to 0.95 respectively. The data have been compared with widely used post-dryout correlations available in the literature. The results show large differences between the various predictions and emphasize the dangers of using any of the correlations outside the range of data used in its derivation. Good agreement with the data was obtained over most conditions by use of the Groeneveld-Delorme correlation which is based on a correlation for thermal non-equilibrium in the steam. (Copyright (c) Central Electricity Generating Board, 1982.)

7285 **Generation and size distribution of droplet in annular two-phase flow.** Kataoka, I.; Ishii, M.; Mishima, K. (Kyoto Univ., Uji, Japan). *Journal of Fluids Engineering;* **105**: 230-238(Jun 1983).

The mean droplet size and size distribution are important for detailed mechanistic modeling of annular two-phase flow. A large number of experimental data indicate that the standard Weber number criterion based on the relative velocity between droplets and gas flow predicts far too large droplet sizes. Therefore, it was postulated that the majority of the droplets were generated at the time of entrainment and the size distribution was the direct reflection of the droplet entrainment mechanism based on roll-wave shearing off. A detailed model of the droplet size in annular flow was then developed based on the above assumption. The correlations for the volume mean diameter as well as the size distribution were obtained in collaboration with a large number of experimental data. A comparison with experimental data indicated that indeed the postulated mechanism has been the dominant factor in determining the drop size. Furthermore, a large number of data can be successfully correlated by the present model. These correlations can supply accurate information on droplet size in annular flow which has not been available previously.

## 4205 Materials Testing

*REFER ALSO TO CITATION(S) 4205006405, 6805, 7183, 7261, 7267*

7286 **(AD-A—142-739) Property screening and evaluation of ceramic turbine materials. Final technical report, July 1979-July 1983.** Larsen, D.C.; Adams, J.W. (IIT Research Inst., Chicago, IL (USA)). Apr 1984. 335p. (AFWAL-TR—83-4141). NTIS, PC A15. File Number DE85900226.

Evaluates state-of-the-art technical ceramics, mainly silicon carbide, silicon nitride and zirconia, that have potential as structural components in advanced gas turbine engines. Thermal and mechanical property data were generated on candidate materials and the results were interpreted with respect to microstructure, purity, secondary phases, environmental effects and processing methods. Measured properties were related to microstructure.

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**7287 (DOE/ER/45057—T1) Investigations of ultrasonic wave interactions at boundaries separating anisotropic materials. Summary report.** Adler, L. (Ohio State Univ., Columbus (USA). Dept. of Welding Engineering). Nov 1984. Contract FG02-84ER45057. 74p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85003506.

The five chapters are titled: theoretical studies of elastic wave interaction with anisotropic boundaries, materials preparation, experimental study of wave propagation in anisotropic materials and scattering, Rayleigh angle backscattering, and beam displacement due to anisotropy.

**7288 (INIS-mf—9093, pp 5-7) Neutron crack detection in Czechoslovakia.** Bizek, V. (Statni Vyzkumny Ustav Materialu, Prague (Czechoslovakia)). 1982. (In Czech). NTIS (US Sales Only), PC A04/MF A01. File Number TI85780142. (CONF-8210310—).

From Crack detection meeting; Olomouc, Czechoslovakia (11 Oct 1928).

Methods of neutron crack detection may currently be used at three institutions in Czechoslovakia. At the Institute of Nuclear Research in Rez near Prague the neutron source is the WWR-S reactor which provides at the point of exposure a neutron flux density in the order of $10^7$ n/cm$^2$.s. The SR-O reactor at the SKODA plant provides at the exposure plane a neutron flux with a density in the order of $10^5$ n/cm$^2$.s. The mobile unit of the State Institute for Materials Research operates a $^{252}$Cf neutron source. The neutron flux density at the point of exposure in this case does not exceed $10^4$ to $10^5$ n/cm$^2$.s.

**7289 (INIS-mf—9093) Crack detection '82.** (Ceskoslovenska Vedeckotechnicka Spolecnost, Prague. Dum Techniky). 1982. 56p. (In Czech). (CONF-8210310—). NTIS (US Sales Only), PC A04/MF A01. File Number DE85780142.

From Crack detection meeting; Olomouc, Czechoslovakia (11 Oct 1928).

A separate abstract was prepared for one paper in this conference proceedings.

**7290 (INIS-mf—9124) Acoustic holography - laboratory experiments and applicational studies. Final report.** Schmitz, V. (Fraunhofer-Gesellschaft zur Foerderung der Angewandten Forschung e.V., Saarbruecken (Germany, F.R.). Inst. fuer Zerstoerungsfreie Pruefverfahren). 1984. 171p. (In German). NTIS (US Sales Only), PC A08/MF A01. File Number DE85780143.

A summary is presented of holographic experiments with excitation of density waves. In these studies the characteristics of the material defects has been varied systematically, starting from machined plane defects parallel to the surface to inclined plane defects and curved defect structures up to natural defects in ferrites, austenites and plated test bodies. In particular, welding seam defects has been studied by a circumferencial recording method and the results are compared with data obtained by the focus technique and by manual testing. In a further section, holographic experiments are presented with artificial and natural defects using transverse waves. The experiences obtained in field studies are described, in particular experiments performed with the high pressure reactor. A three-dimensional imaging technique is presented which allows to represent the spacial distribution of the defects as well as their dimensions. Finally the possibilities are discussed for the application of holography even in the case of strongly curved bodies, and a detailed resume is given of the imaging properties, the instrumental techniques and experiences for the practical application of this method in the industrial field.

**7291 (IS-M—528) Application of hysteresis modelling to the non-destructive inspection of stress.** Jiles, D.C.; Habermehl, S.; Atherton, D.L. (Ames Lab., IA (USA); Queen's Univ., Kingston, Ontario (Canada). Dept. of Physics). Mar 1984. Contract W-7405-ENG-82. 10p. (CONF-8403158—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003081.

From 1. seminar on nondestructive evaluation of ferromagnetic materials; Houston, TX, USA (1 Mar 1984).

To use magnetic methods to study the effects of stress on the properties of ferromagnetic materials it is necessary to have a reliable model of the magnetic hysteresis behaviour of the material. The effects of stress on the various parameters defining hysteresis can then be determined. Later these parameters may be calculated from hysteresis measurements in order to evaluate the stress. The situation is likely to be further complicated by such factors as residual microstrain in the sample and if the elastic limit is exceeded, by plastic deformation. Nevertheless the outlines of the magnetic method given show how it can be used for nondestructive inspection of stress.

**7292 (RFP—3590) Ultrasonic test methods and systems for evaluating depleted uranium penetrators.** Michael, M.D. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 16 Apr 1984. Contract AC04-76DP03533. 84p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85002976.

Numerous studies have been conducted to evaluate the ultrasonic testing methods used for inspecting XM774 depleted uranium cores. This report describes the testing methods, results, and conclusions of these studies. Amplitude response studies indicate large ultrasonic attenuation variations occur within the same core in heat-treated depleted uranium, especially at 5 MHz or higher test frequency. Frequency spectrum analysis reveals an attenuation of high-frequency components of the incident ultrasonic wave, again in heat-treated material at higher frequencies. These observations are especially prevalent when testing in the shear wave or offset mode. A series of standards manufactured at different locations were compared. There was remarkably good correlation of centerline flat-bottom hole response. The machined circumferential and longitudinal slots did not correlate as well; but considering the attenuation characteristics of the material, they were quite good. Distance amplitude correction (DAC) was evaluated to determine if the response from near and far surface reflections could be made more uniform. This method appears to give the desired results and is a viable test. These studies indicate heat-treated depleted uranium has significant effects on ultrasonic test parameters, especially at higher frequencies.

**7293 (UCID—20238) Analysis of a 50 cm diameter electroformed copper target that failed during hydrotesting.** Kershaw, R.P. (Lawrence Livermore National Lab., CA (USA)). Sep 1984. Contract W-7405-ENG-48. 15p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85002549.

The RTNS-II facility at LLNL uses 50 cm diameter electroformed copper targets for the production of neutrons used in the study of radiation damage of materials. One of these targets failed during a post manufacture hydrotest. This report identifies the causes that led to this failure, i.e., an insufficient pre-plating cleaning operation, and an interruption of the electroforming process.

**7294 (DOE-tr—265) Effect of electrode vibration on arc welding process and on weld properties.** Alov, A.A.; Vinogradov, V.S. Translated from *Svarochnoe Proizvodstvo ;* **9**: 19-22(Sep 1958). Contract AC04-76DP00053. 14p. NTIS, PC A02. File Number DE85000650. DE85000650

This paper covers investigations of effects of electrode vibration on fusion of electrodes. The stability of arc and the transfer of metal from electrode to puddle is studied. Also studied in the distribution of gas porosity and formation of weld based on welding experiments with low-carbon steel strip and aluminum plate.

## 4206 Safety Engineering

*REFER ALSO TO CITATION(S) 4206006597, 7542*

**7295 Performance and reliability of automatic fire extinguishing systems in energy systems.** Maybee, W.W. (Department of Energy, Washington, DC). pp 27-28 of Shaping our energy future. Knoxville, TN, USA; LTM Consultants (1984). (CONF-840229—).

From 11. annual WATTec conference and exposition - shaping our energy future; Knoxville, TN, USA (21 Feb 1984).

Abstract only.

This paper discusses details of the performance and reliability of the numerous sprinkler systems and halon systems installed

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throughout DOE facilities nationwide. Of particular interest is the discussion of sprinkler protection in areas containing vital electrical and/or computer equipment and a discussion of the excellent performance record of sprinkler systems over the past 30 years. The program also touches on several unique fire protection situations encounted by DOE such as the following: a fire which originated in a concrete block a single fire which opened 2,341 sprinkler heads on 23 separate sprinkler systems a warehouse with values exceeding $1.0 million per square foot.

## 4208 Electronic Circuits And Devices

*REFER ALSO TO CITATION(S) 4208007057, 7062*

7296 **(DOE/ER/10740—13) Microstrain analysis in bent single crystal silicon by double crystal x-ray topography technique.** Emamian, M.M. (State Univ. of New York, Stony Brook (USA). Dept. of Materials Science and Engineering). May 1984. Contract AC02-80ER10740. 95p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85000422.

In many important materials engineering applications such as integrated circuit devices, thin film amorphous solar cells, magnetic thin films and corrosion protection, it is important to obtain the maximum mechanical integrity of film-substrate interfaces in order to maintain uniformity of desired properties. Since the various deposition methods for fabricating film-substrate combinations produce internal strains in the material, it is convenient to devise a suitable method for monitoring these strains. Though limited in ultimate geometrical resolution, x-ray methods have the advantages of extremely high strain sensitivity and the ability to vary penetrating depth through the control of wavelength; they are nondestructive, and with modern computer control assistance, analysis can be made rapidly, accurately and safely. No commercial camera is currently available to fully exploit this new technology. The work reported within concerns the design and application of an automated Double Crystal X-ray Diffraction Topography camera capable of measuring radii of curvature over a range of 0.2 to 1000 meters for crystals bent due to internal stress. The corresponding strain sensitivity is of the order of $10^{-7}$. Calibration experiments showed that these determinations could be made with an accuracy of +- 10%. Observations using this technique are reported for several types of thin films on silicon substrates.

7297 **(DOE/IG—0213) Planned expansion of microelectronics capability at Sandia National Laboratory.** (USDOE Office of Inspector General, Washington, DC). 14 Dec 1984. 95p. OSTI. File Number TI85004326.

Report to the Secretary.

This report gives the results of an inspection of the planned expansion of microelectronics activities at Sandia National Laboratory, including the Radiation-Hardened Integrated Circuit (RHIC) Laboratory Facility. The RHIC facility, a development and production facility to be operational in 1987, is the cornerstone of the planned expansion in microelectronics. The review determined that the case for additional facilities, amounting initially to $41 million but expected to increase in the future to over $200 million, had not been made.

7298 **(GEPP-OP—802b) Review of anode phenomena in vacuum arcs.** Miller, H.C. (General Electric Co., St. Petersburg, FL (USA). Neutron Devices Dept.). 1984. Contract AC04-76DP00656. 9p. (CONF-840981—4). NTIS, PC A02/MF A01; GPO Dep. File Number DE85002736.

From 11. international symposium on discharges and electrical insulation in vacuum; Berlin, F.R. Germany (24 Sep 1984).

This paper discusses five possible arc modes at the anode, anode temperature measurements, anode ions, transitions of the arc into various modes, and theoretical explanations of anode phenomena.

7299 **(LA-UR—84-392) Design of explosive logic elements.** Meyers, W.H. (Los Alamos National Lab., NM (USA)). 1984. Contract W-7405-ENG-36. 18p. (CONF-840383—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE84009611.

From 12. symposium on explosives and pyrotechnics; San Diego, CA, USA (13 Mar 1984).

Los Alamos has been exploring explosive logic systems to see if they might provide advantages in weapon safety or weapon command and control. We use the extrudable explosive EXTEX (80% PETN, 20% Sylgard) for this work. These systems contain at least one but usually several discrete logic elements, and the worth - the reliability - of the system is directly dependent on the reliability of these elements. We perceive that the troubles encountered in the early attempts to use explosive logic can be attributed to the lack of a truly reliable design for one or more of the elements being used. At Los Alamos, we express this as the need for a Safety/Reliability Window. In this short presentation, that concept will be emphasized. The development of three elements for which working windows are available will be discussed.

7300 **Demonstration of electro-optical switching at the 26 cm x 26 cm aperture using plasma electrodes.** Henesian, M.A.; Goldhar, J. (Lawrence Livermore National Laboratory, University of California, P. O. Box 5508, L-490, Livermore, California 94550). *Optics Letters;* 9: No. 11, 516-518(Nov 1984). Contract W-7405-ENG-48.

We have constructed and tested a longitudinal Pockels cell with a clear aperture of 26 cm x 26 cm. Transparent plasma electrodes formed in a low-pressure glow discharge were used to apply a uniform electric field to a 1-cm-thick KDP crystal. Optical switching times of 50 nsec were achieved with a bare KDP crystal. Significant improvement in switching time resulted from using a glass-plate-KDP-crystal sandwich.

7301 **Stepping motor controller.** Bourret, S.C.; Swansen, J.E. (to Dept. of Energy). US Patent 4,464,616. 7 Aug 1984. Filed date 2 Jul 1982. vp.

PAT-APPL-394558.

A stepping motor is microprocessingly controlled by digital circuitry which monitors the output of a shaft encoder adjustably secured to the stepping motor and generates a subsequent stepping pulse only after the preceding step has occurred and a fixed delay has expired. The fixed delay is variable on a real-time basis to provide for smooth and controlled deceleration.

7302 **Organic conductive films for semiconductor electrodes.** Frank, A.J. (to Dept. of Energy). US Patent 4,461,691. 24 Jul 1984. Filed date 10 Feb 1983. vp.

PAT-APPL-465418.

According to the present invention, improved electrodes overcoated with conductive polymer films and preselected catalysts are provided. The electrodes typically comprise an inorganic semiconductor overcoated with a charge conductive polymer film comprising a charge conductive polymer in or on which is a catalyst or charge-relaying agent.

## 4209 Waste Processing Plants And Equipment

7303 **Utilization of solar energy for sludge drying beds.** El-Ariny, A.S.; Miller, H.I. (Jefferson Parish Department of Public Utilities, Metairie, LA). *Journal of Solar Energy Engineering;* **106**: No. 3, 351-357(Aug 1984).

The present work is aimed to assess experimentally solar heated sludge drying beds located in the New Orleans, Louisiana metropolitan area with an appropriately sized solar system designed to operate on a fiberglass-covered drying bed. Another open drying bed was left without solar heating for comparative purposes. Five experimental runs were conducted over a one-year period to account for all weather conditions utilizing aerobically digested waste activated sludge. Compared to conventional beds, the solar beds achieved an average reduction of 50 percent in the drying period required to obtain a total solids concentration of 30 percent and an average reduction of 60 percent in the drying period of sludge to reach a total solids concentration of 60 percent. Sludge of total solids content of more than 90 percent was produced in an average period of 20 days under the solar drying process. System energy effects and economic analysis were also discussed.

### 4210 Combustion Systems

*REFER ALSO TO CITATION(S) 4210006254, 6352, 6978, 7012, 7013, 7039*

7304 **(DOE/ER/13038—T1) Turbulent premixed flame study. Progress report, December 1, 1983-October 15, 1984.** Cheng, W.; Keck, J.; Pope, S.; Hainsworth, E.; Lin, K. (Massachusetts Inst. of Tech., Cambridge (USA)). 30 Oct 1984. Contract AC02-83ER13038. 29p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85003220.

The research program described here is the work of the second year period of a three year effort on the understanding of turbulent premixed flames. The program includes both an experimental effort to measure the pertinent properties of a statistically spherical flame propagating in a turbulent environment, and a theoretical effort based on the solution of the probability density function (pdf) of a progressive variable of the reacting system by the Monte-Carlo method. In the first year, the apparatus and instrumentation of the experiment was set up. The basic computer program for the Monte-Carlo calculation was written. Substantial progress in both the experimental and theoretical effort has been made in the second year. Experimental data on the characteristic of the turbulent flow in terms of hot wire velocity measurements, and the flame development in terms of high speed Schlieren movies have been obtained. The flame Schlieren image recorded on film showed a highly irregular structure, and, in some cases, instead of obtaining a growing flame ball, the flame kernel extinguished. On the theoretical side, the pdf formulation was generalized from a plane to a spherical geometry, and the density was no longer assumed to be constant to account for the thermal expansion of the combustion products. Calculation for a statistically spherical flame similar to the experimental condition had been completed.

7305 **(DOE/MC/20334—T13) Study of deposition control using transpiration. Technical progress report.** Louis, J.F.; Kozlu, H. (Massachusetts Inst. of Tech., Cambridge (USA)). Nov 1984. Contract AC21-83MC20334. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003463.

The purpose of this project is to determine the conditions under which transpiration may be actually used to avoid the deposition of small particles. The application of this work is the control of the deposition of small particles over a surface kept at a temperature below the melting point of compounds likely to exist in the combustion products. A combined experimental and theoretical research program will be carried out to evaluate the concept of transpiration as a deposition control strategy. A first order theory will be refined by introducing an appropriate turbulence model. The experimental program is designed to evaluate and refine the theoretical model under conditions which provide the correct Reynolds and Stokes numbers. The experimental setup consists of a wind tunnel with a test section containing a flat porous transpired section. The measurements will determine the distribution of velocity and of particle concentration in the boundary layer. The experiments will be conducted for different particle sizes under conditions simulating gas turbine conditions.

7306 **(SAND—84-8928) Experimental investigation of a pulse combustor - flow visualization by schlieren photography.** Keller, J.O.; Saito, K.; Kishimoto, K. (Sandia National Labs., Livermore, CA (USA); Toshiba Corp., Fuji City (Japan); Kokushikan Univ., Tokyo (Japan)). Nov 1984. Contract AC04-76DR00789. 19p. (CONF-8410156—5). NTIS, PC A02/MF A01; GPO Dep. File Number DE85002862.

From Fall meeting of the Western States Section of the Combustion Institute; Stanford, CA, USA (22 Oct 1984).

Pulse combustion devices exhibit exceedingly high thermal efficiency and very low pollutant emission when used in heating applications. The application of these heating devices has been limited, however, because of a lack of understanding of the fundamental controlling physical and chemical processes governing pulse combustors. An experimental research program has been initiated that uses high-speed schlieren movies, phase-locked schlieren Polaroid still photographs, and OH chemiluminescence as diagnostic tools to understand the fundamental processes governing pulse combustion. The periodic nature of the combustion process is shown in the schlieren records taken of a valved square combustor of the Helmholtz type. The data presented in this paper demonstrate the complex nature of this combustion process. The results show that a flame always exists in the combustor, acting as an ignition source for the next cycle. A rapid short-lived combustion process is responsible for the fast pressure rise and, hence, the pulsations.

### 4220 Underground Engineering

*REFER ALSO TO CITATION(S) 4220006338, 6481*

### 4240 Pollution Control Equipment

*REFER ALSO TO CITATION(S) 4240006309, 6315, 6316, 6318*

### 4250 Power Cycles

*REFER ALSO TO CITATION(S) 4250006967*

## 43 PARTICLE ACCELERATORS

### 4301 Design, Development, And Operation

*REFER ALSO TO CITATION(S) 4301007702*

7307 **(BNL—35347) Relativistic heavy ions at BNL: ongoing projects and plans for the future.** Chasman, C.; Thieberger, P. (Brookhaven National Lab., Upton, NY (USA)). 1984. Contract AC02-76CH00016. 17p. (CONF-841117—22). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003628.

From 8. conference on the application of accelerators in research and industry; Denton, TX, USA (12 Nov 1984).

The AGS at Brookhaven National Laboratory is now being prepared to accelerate heavy ions up to mass 32 to energies of ~ 15 GeV/A. Negative ions are to be made in a sputter ion source, accelerated in the BNL tandems to energies of ~ 7 MeV/A, stripped of all electrons, and transported the 2100′ to the AGS. Some considerations for the injection and acceleration of Tandem beams directly into the AGS are described as are future plans for the acceleration of heavier mass ions in the AGS and ultimately the acceleration of ions in a two ring collider (RHIC) to 100 GeV/A. The physics programs for which these accelerators are designed are briefly discussed. 19 references, 4 figures, 3 tables.

7308 **(INIS-mf—9082) KVI Annual Report 1982.** (Rijksuniversiteit Groningen (Netherlands). Kernfysisch Versneller Inst.). Apr 1983. 161p. NTIS (US Sales Only), PC A08/MF A01. File Number DE85780128.

This annual report offers 93 informative descriptions of the current research projects at the KVI cyclotron during 1982. The projects are classed under the following heads: elastic and inelastic scattering; giant resonances; transfer and charge exchange reactions; breakup reactions; heavy ion reactions; electromagnetic and weak interactions; theoretical nuclear physics; atomic physics; nuclear solid state physics; cyclotron, computers and instrumentation; nuclear medicine; environmental studies.

7309 (INIS-SU—228, pp 255-262) **Projects for new accelerators for study on nuclear electromagnetic interactions.** Solodukhov, G.V. (AN SSSR, Moscow. Inst. Yadernykh Issledovanij). 1982. (In Russian). NTIS (US Sales Only), PC A13/MF A01. File Number TI84780397. (CONF-8106173—).

From 5. seminar on electromagnetic interactions of nuclei at low and medium energies; Moscow, USSR (15 Jun 1981).

Designs of new electron accelerators of third generation intended for investigation of nuclei electromagnetic interactions are described. The accelerators of design parameters (electron energy is 1-2 GeV, coefficient of time occupation by the beam is 100%, beam current is 100 μA) are subdivided into 3 categories: 1) accelerators

with a beam uninterrupted in time with beam recirculation using superconducting accelerating structures on standing wave; 2) accelerators with a beam uninterrupted in time with beam recirculation using "warm" accelerating structures on standing wave and 3) pulsed accelerators with low occupation coefficient operating in combination with beam-stretcher of the beam. Analysis of the designs has revealed that use of beam recirculation is an inalienable feature of all the accelerators of continuous operation. It is also revealed that pulsed accelerators (linear or split microtron) with the ring-stretcher are perspective ones.

7310 (Juel-Spez—255, pp 119) **Cyclotron operation and improvement.** Boege, H.G.; Braeutigam, W.; Borsch, H.; Brings, R.; Fiedler, R.; Hadamek, H.; Jannakos, I.; Lawin, H.; Reich, J.; Retz, A. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

7311 (Juel-Spez—255, pp 131-132) **First experimental results of an operation in the 9ω-mode.** Wucherer, P. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

7312 **(SLAC-PUB—3476) Design of a semi-custom integrated circuit for the SLAC SLC timing control system.** Linstadt, E. (Stanford Linear Accelerator Center, CA (USA)). Oct 1984. Contract AC03-76SF00515. 2p. (CONF-841007—29). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003091.

From Nuclear science symposium; Orlando, FL, USA (31 Oct 1984).

A semi-custom (gate array) integrated circuit has been designed for use in the SLAC Linear Collider timing and control system. The design process and SLAC's experiences during the phases of the design cycle are described. Issues concerning the partitioning of the design into semi-custom and standard components are discussed. Functional descriptions of the semi-custom integrated circuit and the timing module in which it is used are given.

## 4302 Beam Dynamics, Field Calculations, And Ion Optics

7313 **(BNL—35244) Crossing point conditions, quadrupole gradients and drift space lengths.** Claus, J. (Brookhaven National Lab., Upton, NY (USA)). 1984. Contract AC02-76CH00016. 17p. (CONF-8406198—22). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003223.

From Design and utilization of the superconducting super collider summer study; Snowmass, CO, USA (23 Jun 1984).

The values for the B's in a crossing point of a superconducting storage ring system tend to be inversally proportional to the peak B values elsewhere in the ring with a constant of proportionality that is largely determined by the configuration of driftspaces and quadrupoles in its immediate vicinity. The value of the constant tends to increase faster than quadratically with the distance from the crossing point to the entrance of the first quadrupole and about as $K^{-3/4}$ with K (K = B'/Brho), for K values likely to be available at SSC energies. It appears important to build this section as compactly as possible. The characteristics of a number of possible configurations were calculated, and are discussed; some numerical results are represented graphically. These front sections are to be connected to the adjoining arcs via matching sections which match the unavoidable large peak B values to the ones that prevail in the arcs. Two specific examples of complete half insertions, consisting of a front section and a matching section are described and their characteristics are tabulated.

7314 (Juel-Spez—255, pp 120-121) **Measurement of transfer coefficients and improvements in the beam handling system.** Rogge, M.; Reich, J.; Zemlo, L.; Roemer, J.G.M.; Berg, G.; Hlawatsch, G.; Lawin, H.; Meissburger, J.; Oelert, W.; Riepe, G. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

7315 (Juel-Spez—255, pp 129-130) **Check of the ISIS-center-region.** Wucherer, P.; Rindfleisch, U.; Hagedoorn, H.L. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

7316 **(ORNL/TM—9375) Calculations pertaining to the design of a prebuncher for a 150-MeV electron linear accelerator III. Comparisons with experimental data.** Alsmiller, R.G. Jr.; Alsmiller, F.S.; Lewis, T.A. (Oak Ridge National Lab., TN (USA)). Nov 1984. Contract AC05-84OR21400. 22p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85002866.

In a previous paper a ballistic model that included space-charge effects was described and calculated results were presented of the extent to which a current pulse of electrons (~ 150 keV kinetic energy, ~ 1 μC of charge, and ~ 15 nsec full width at half maximum) could be bunched, i.e., reduced in width without loss of charge, by passing it through a series of gaps on which time-dependent voltages are applied. A prebuncher system similar to the one considered previously has now been constructed, and experimental data on the current at the end of the prebuncher as a function of time have been obtained. Here the calculated current as a function of time, obtained using the model developed previously, is compared with the experimental data. The calculated and experimental data are in substantial agreement for a variety of electron beam and voltage gap conditions. 6 references, 9 figures.

7317 **(SAND—84-1785) Field solver comparisons between the 3-D non-linear electron beam propagation code DYNADISC and the linearized code (OOSIK).** Freeman, J.R.; Wagner, J.S. (Sandia National Labs., Albuquerque, NM (USA)). Nov 1984. Contract AC04-76DP00789. 24p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003267.

Field solver comparisons between DYNADISC, a 3-D non-linear PIC code, and OOSIK, a linearized hose code, are presented. Good agreement was obtained for both the field quantities and the self-consistent transverse forces on displaced segments of the beam. These tests provided increased confidence in the accuracy of both field solvers.

7318 **(UCID—20263) Experiments on ETA comparing wire-conditioned and non-wire-conditioned beam propagation.** Clark, J.C.; Lauer, E.J.; Prono, D.S.; Struve, K.W. (Lawrence Livermore National Lab., CA (USA)). 18 Jan 1984. Contract W-7405-ENG-48. 37p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85004451.

This report describes experiments in beam propagation with the ETA beam during 1982 following accelerator cavity modifications which allowed a maximum beam current of up to 8 kA at the entrance to the propagation tank. A prominent new feature of the propagation in high pressure gas was an enhancement of the net current as the beam propagated. In some cases this enhanced current was nearly double the injected beam current. The strong current enhancement was associated with strong transverse hose motion of the beam. The absence of microwave emissions in the range from 6.6 GHz to 31 GHz indicates that this current enhancement is not due to a two-stream instability.

7319 **(UCID—20264) Survey of initial experiments on ATA beam dynamics.** Prono, D.S.; Caporaso, G.J.; Chong, Y.P.; Fessenden, T.J.; Hester, R.E.; Lauer, E.J.; Orzechowski, T.J.; Paul, A.C.; Weir, J.T. (Lawrence Livermore National Lab., CA (USA)). 25 Jun 1984. Contract W-7405-ENG-48. 33p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85004410.

The Advanced Test Accelerator (ATA) is a linear induction electron accelerator whose design parameters are 50 MeV, 10 kA and 70 ns pulse duration. The key physics issues affecting performance of the accelerator involve beam dynamics during transport

through the accelerator structure. In this report, we present experimental results describing the initial operating phases of ATA. These results illustrate the complexity of the beam transport phenomena but also indicate the means to stabilize beam dynamics. Improvements in beam transport, which result from deploying various stabilization techniques, are also presented.

7320 **Longitudinal stability of a coasting beam in a resistive vacuum chamber with cylindrical resonant cavity. Pt. 2. Graphs and a formula for the coupling impedance.** Warnock, R.L.; Bart, G.R. (Lawrence Berkeley Lab., CA). *Particle Accelerators;* **15**: No. 1, 1-33(Apr 1984). Contract AC03-76SF00098.

The longitudinal coupling impedance of a cylindrical tube with pillbox cavity is computed by means of cavity-mode equations derived in Part I. The equations are solved by a method in which the resonant mode is first eliminated. The method leads to a rapidly convergent iteration which takes account of cavity-tube coupling in a stepwise manner. Numerical results are given for a wide range of parameters, with full account of wall resistance. The formula for the impedance in the limit of small tube radius, modified by a simple factor, approximates the numerical values and provides an overview of parameter dependences. Results are given for nonrelativistic velocities, and the exponential decrease of impedance with cavity depth that occurs at low velocity is studied.

## 4303 Auxiliaries And Components

*REFER ALSO TO CITATION(S) 4303007314, 7337*

7321 **(BNL—34938) Laser-Electron-Gamma-Source. Progress report, June 1984.** Dowell, D.H.; Giordano, G.; LeVine, M.J.; Matone, G.; Sandorfi, A.M.; Schaerf, C.; Thorn, C.E.; Ziegler, W. (Brookhaven National Lab., Upton, NY (USA)). 1984. Contract AC02-76CH00016. 7p. (CONF-8407104—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003204.

From Gordon conference; Tilton, NH, USA (9 Jul 1984).

Construction of the Laser Electron Gamma Source (LEGS) began at Brookhaven in October 1983. When completed, the source will provide intense beams of monochromatic and polarized gamma rays with energies in the range of several hundreds of MeV. The planned layout of this facility with its experimental areas is shown. The gamma-ray beams will be produced by Compton backscattering uv laser light from the electrons circulating in the 2.5-3.0 GeV X-RAY storage ring of the National Synchrotron Light Source (NSLS) at BNL. The X-RAY ring is currently running with 50 mA at 1.7 GeV, and is expected to reach 2.5 GeV by November 1984. There is as yet no firm schedule for operation at 3.0 GeV, although some initial testing should be completed by the end of 1986. The availability of the 210-420 MeV LEGS beam will depend upon these 3 GeV studies.

7322 **(FNAL-TM—1285) Water cooling considerations for the SSC.** O'Meara, J. (Fermi National Accelerator Lab., Batavia, IL (USA)). 2 Nov 1984. Contract AC02-76CH03000. 18p. NTIS, PC A02/MF A01. File Number DE85003721.

The purpose of this note is to specify parameters for hypothetical SSC water cooling systems, in order that the comparative advantages of these system can be studied. The various methods of heat rejection considered include: cooling towers, cooling ponds, ground water recharge system, water-to-air (dry) cooling towers, use of tunnel sump water, or some combination.

7323 **(FNAL-TM—1287) Fermilab magnet development and test facility GPIB package.** McGuire, K. (Fermi National Accelerator Lab., Batavia, IL (USA)). Nov 1984. Contract AC02-76CH03000. 30p. NTIS, PC A03/MF A01. File Number DE85003722.

This package has been developed for communicating with devices on the GPIB (General Purpose Interface Bus - IEEE Std. 488). Programs and subroutines which call the routines in this package communicate with devices on the GPIB via a GPIB controller residing in a CAMAC crate. CAMAC access is done in 16-bit transfers. The target hardware is a DEC VAX 730 which communicates with a byte-serial CAMAC loop through a Jorway Model 411 PDP-11 CAMAC Interface. CAMAC in turn, communicates with the GPIB through a Kinetic Systems Model 3388-G1A GPIB Interface. Although this is the hardware that is used at our installation, the software is designed to be used on other systems with a minimum of modifications.

7324 **(INIS-mf—9081) NIKHEF-K safety report 1982.** (Nationaal Inst. voor Kernfysica en Hoge-Energiefysica (NIKHEF), Amsterdam (Netherlands). Sectie K). Dec 1983. 17p. (In Dutch). NTIS (US Sales Only), PC A02/MF A01. File Number DE85780141.

In this safety report, general information is offered about the safety policy at the NIKHEF-K institute Amsterdam. Costs, prevention, training courses and inspection related to (radiation) safety are briefly discussed. Small accidents are reported. Some measurements have been carried out, but no measurable increase of radiation doses have been found.

7325 **(INIS-SU—228, pp 263-273) 1,5 GeV electron linac and pulse stretcher ring at Tohoku University.** Sugawara, M. (Tohoku Univ., Sendai (Japan). Lab. of Nuclear Science). 1982. NTIS (US Sales Only), PC A13/MF A01. File Number TI84780397. (CONF-8106173—).

From 5. seminar on electromagnetic interactions of nuclei at low and medium energies; Moscow, USSR (15 Jun 1981).

The project of the 1.5 GeV electron linac and pulse stretcher ring at Tohoku University is described. The 1.5 GeV linac consists of 32 accelerating tubes and is about 240 m long. Then it is followed by an energy compressing system which improves energy spread of the electron beam. At the exit of the linac every third or sixth beam pulse is deflected by a kicker magnet toward a neutron diffraction hall. Most of the beam pulse are deflected about 80 degrees toward the area for nuclear physics experiments. The linac has thirty-four 30 MW klystrons. The circumference of pulse stretcher ring is 160 m. 150 MeV pulse strethcer is under construction at present. Some of the parameters of this pulse stretcher are given.

7326 **(Juel-Spez—255, pp 122) Progress of the project ISIS (Injection of heavy ions after ECR-stripping) in 1983 is described for the different subsystems.** Beuscher, H.; Briell, W.; Fiedler, R.; Krauss-Vogt, W.; Mathews, H.G.; Retz, A.; Rindfleisch, U. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

7327 **(Juel-Spez—255, pp 125-127) Pre-ISIS 2 * - a two stage ECR source for highly stripped light heavy ions.** Mathews, H.G.; Beuscher, H.; Fiedler, R.; Krauss-Vogt, W. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

7328 **(Juel-Spez—255, pp 128) Computer calculation on the ECR ion source extraction.** Krauss-Vogt, W.; Beuscher, H.; Mathews, H.G. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

7329 **(KFK—3718) Magnetic field measurements in the electron cooling device for LEAR.** Wolf, A.; Huetten, L.; Poth, H. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Kernphysik). Jun 1984. 60p. NTIS (US Sales Only), PC A04/MF A01. File Number DE84752339.

The field of the solenoid magnet to be used in the electron cooling device for LEAR has been investigated by careful field mapping. The magnetic field guiding the electron beam was measured in a volume with a cross-section of 6 x 6 $cm^2$ around the electron beam axis, which is 4.5 m long and bent twice in toroidal sec-

tions. A Hall-plate field scanner designed for the mapping of dipole magnets was used to obtain separate field maps of all Cartesian field components in rectangular boxes covering the aforementioned measuring region. For merging these maps into a consistent overall field table, an evaluation procedure has been developed that includes careful survey and the correction of errors inherent in Hall-probe measurements. The measured data are presented in plots of field components and of field lines, and the magnetic field properties of the electron cooling device are discussed. A short description of the computer programs produced during this work is also given.

7330 **(LBL—17996-Rev.) Continuous liquid sheet generator for ion stripping. Revision.** Gavin, B.; Batson, P.; Leemann, B.; Rude, B. (Lawrence Berkeley Lab., CA (USA)). Oct 1984. Contract AC03-76SF00098. 12p. (CONF-841117—21-Rev.). NTIS, PC A02/MF A01; GPO Dep. File Number DE85002900.

From 8. conference on the application of accelerators in research and industry; Denton, TX, USA (12 Nov 1984).

Many of the technical problems of generating a large thin liquid sheet from 0.02 to 0.20μm thick (3 to 40μg/cm²) have been solved. It is shown that this perennial sheet is stable and consonant in dimension. Several ion beam species from the SuperHILAC have been used for evaluation at 0.11 MeV/n. In one of three modes this sheet serves as an equivalent substitute for a carbon foil. The second mode is characterized by a solid-like charge state distribution but with a varying fraction of unstripped ions. The third mode gives stripping performance akin to a vapor stripping medium.

7331 **(LBL—18501) Performance of the LBL ECR ion source.** Lyneis, C.M. (Lawrence Berkeley Lab., CA (USA)). Oct 1984. Contract AC03-76SF00098. 15p. (CONF-841117—25). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003471.

From 8. conference on the application of accelerators in research and industry; Denton, TX, USA (12 Nov 1984).

The LBL Electron Cyclotron Resonance (ECR) ion source in test operation since January 1984 has produced a wide variety of high charge state ion beams suitable for injection into the 88-Inch Cyclotron. Two recent developments have dramatically improved the capability of the ECR source. The first development was the production of metallic ions. The intensities of aluminum ions produced were 36, 22, 10, and .065 eμA for charge states 6, 7, 8, and 11, respectively. Calcium ion intensities were 36, 31, 4.6, and 0.20 eμA for charge states 8, 9, 12, and 14, respectively. The second development was the replacement of the sextupole magnet used in of all other high charge state ECR sources with an octupole structure. This modification resulted in a dramatic improvement in the intensities of the high charge state beams and a significant upward shift in the charge state distribution (C.S.D.). The ECR-octupole or OCTIGUN has produced 89, 52, 9, and 2.5 eμA of Ar/sup 8,9,11,12+/ and 21, 10, and 0.34 eμA of Kr/sup 10,14,18+/, respectively. For the high charge states of argon and krypton the improvement gained by using the octupole is typically a factor of 5 to 10.

### 4304 Storage Rings

*REFER ALSO TO CITATION(S) 4304007325*

7332 **(BNL—35401) Electron storage ring beam lifetime dependence on pressure and pumping speed.** Halama, H.J. (Brookhaven National Lab., Upton, NY (USA)). 1984. Contract AC02-76CH00016. 19p. (CONF-841218—6). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003208.

From 31. national vacuum symposium; Reno, NV, USA (3 Dec 1984).

The beam loss in electron storage rings depends to a large extent on the interaction of the beam with heavier residual gas molecules such as CO, $CO_2$ and A due to Bremsstrahlung and Coulomb scattering. The gas density inside the vacuum chamber is determined by the surface condition of the vacuum chamber which is bombarded by photons (synchrotron radiation) generated by circulating electron beams and by the installed pumping. During the spring shutdown the x-ray ring vacuum system was updated and baked out. Residual gas spectra obtained were typical of a well baked out system, i.e., hydrogen constituted ~ 95% of the gas and the average pressure was in the $10^{-10}$ Torr range. During initial operation the composition of desorbed gases was 43% $H_2$, 25% CO and 16% $CO_2$ and $CH_4$. After 3 months of beam conditioning desorption dropped by a factor of 5 and the CO, $CO_2$ and $CH_4$ peaks represented smaller percentage of total desorbed gas. Beam lifetime did not, however, show a corresponding increase. The pumping speed of distributed pumps dropped to zero at 1 x $10^{-9}$ Torr pressure but increased rapidly from ~ 20l/s in low $10^{-9}$ as the pressure increased.

7333 **(DOE/SF/00515—T41) Activity report to National Science Foundation, April 1, 1976-December 31, 1976.** Doniach, S.; Winick, H. (Stanford Univ., CA (USA). W.W. Hansen Labs. of Physics). 1977. Contract AC03-76SF00515. 91p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85003289.

During the period of this report the photon power of Stanford Synchrotron Radiation Project (SSRP) was roughly doubled with the addition of the new second beam line. This beam initially started up with the second channel-cut crystal monochromator system during the May-July 1976 run and, during the October to December run, the eight-millirad X-ray focusing mirror was installed and equipped with a two crystal (parallel mode) monochromator. In addition to this, the five-millirad beam port on Beam Line II, (so far not equipped but planned for a future diffractometer port) was specially equipped by the Oak Ridge group with a curved-crystal graphite monochromator for the heavy element search.

7334 (Juel-Spez—255, pp 133-134) **Cooler storage ring COSY.** Berg, G.; Osterfeld, F.; Prasuhn, D.; Rogge, M.; Rossen, P. von; Turek, P.; Martin, S.; Gaul, G.; Hagedoorn, H.; Heide, J.A. van der. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

7335 (Juel-Spez—255, pp 135) **Lattice studies for the cooler storage ring COSY.** Berg, G.; Magiera, A.; Martin, S.; Prasuhn, D. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

## 44 INSTRUMENTATION

### 4401 Radiation Instrumentation

*REFER ALSO TO CITATION(S) 4401006766, 7181, 7602, 7607, 7699, 7892, 7916*

7336 **(CONF-8409161—3) Digital approach to neutron dosimetry and microdosimetry.** Turner, J.E.; Hamm, R.N.; Hurst, G.S.; Wright, H.A. (Oak Ridge National Lab., TN (USA)). 1984. Contract AC05-84OR21400. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85001128.

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

Work has begun in an effort to develop a new, digital approach to neutron dosimetry. In contrast to analogue methods in current use, digital information describes the track of a recoil charged particle produced by a neutron in a gas in terms of the numbers of ions that occur in given volume elements of a detector. It appears that a device based on the time-projection chamber used in particle physics would enable one to measure relevant data for neutron dosimetry. Such an instrument would also furnish data sought in microdosimetry. In this paper we will describe the digital approach to dosimetry and will report on the initial Monte Carlo calculations of the detailed transport of protons and electrons in Ar, $CH_4$, and P-10 gases. These calculations are being used to assess the feasibility of constructing a practical chamber for use in neutron dosimetry and in microdosimetry.

7337 (FNAL/C—84-116) **Development of proportional counters using photosensitive gases and liquids.** Anderson, D.F. (Fermi National Accelerator Lab., Batavia, IL (USA)). Oct 1984. Contract AC02-76CH03000. 10p. (CONF-841007—28). NTIS, PC A02. File Number DE85002870.

From Nuclear science symposium; Orlando, FL, USA (31 Oct 1984).

An introduction to the history and to the principle of operation of wire chambers using photosensitive gases and liquids is presented. Their use as light sensors coupled to Gas Scintillation Proportional Counters and $BaF_2$, as well as their use in Cherenkov Ring imaging, is discussed in some detail. 42 references, 21 figures.

7338 (FS—83-32-T, pp 505-518) **Sensitivity of contamination measuring instruments for actual contaminations at the Juelich isochronous cyclotron - problems of determination of limit values for normal operation.** Uray, I.; Probst, H.J. Nov 1983. (In German). Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland). (CONF-8306168—).

From 17. annual meeting of Fachverband fuer Strahlenschutz e.V.; Aachen, F.R. Germany (8 Jun 1983).

It is relatively simple to assign values to contamination measuring devices for definite radioactive nuclides which correspond to the thresholds named in the StrlSchV and are valid for contamination limits in the diverse radiation protection areas as well as in the non-radiation protection area. For the practical work, however, (like that at the isochronous cyclotron in Juelich) in general not only the existing nuclides but also the composition ration of the nuclides in the contaminations are unknown. In such cases the question arises immediately, which values have to be assigned on the contamination measuring devices. In order to clarify the matter, the detection efficiencies of some devices were determined for actual contaminations (wipe samples from the cyclotron vault and from other places), for some single nuclides, as well as for nuclide mixtures. When the activities of the samples were not known, especially in the case of the wipe samples, they were determined using Ge(Li)- and Si(Li)-detectors. The results are important from two points of view: 1) The efficiencies of the contamination measuring devices differ from each other for the various samples by more than two orders of magnitude. This result is independent of the type of the device. (The efficiency for the wipe samples alone differs by more than one order of magnitude.) 2) For a greater part of the investigated samples the count-rate, corresponding to the limit of the non-radiation protection area, constitutes only a fraction of the background count-rate of the measuring devices. In this situation it seems necessary that in accordance with the StrlSchV the competent authority allows exceptions from the formal fulfilment of the contamination requirements. This is possible because the conditions - unproportionately high effort for the formal realisation and no influence on the radiation protection in case of grant of exception - seem to be satisfied.

7339 (FS—83-32-T, pp 519-527) **$\alpha/\beta$ contamination detectors especially for release measurements of reactor components from nuclear power plants.** Keller, M. Nov 1983. (In German). Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland). (CONF-8306168—).

From 17. annual meeting of Fachverband fuer Strahlenschutz e.V.; Aachen, F.R. Germany (8 Jun 1983).

Dismantled contaminated plant components from nuclear engineering facilities often have a high material value and must be decontaminated before they can be reutilized without hazard. Before the decontaminated plant components are released it must be ensured that any residual activities possibly still present are below the permissible limits. For this purpose special detectors for contamination measurements covering extremely bent cylindrical surfaces, as for example pipes, have been developed at the KFA. These contamination detectors consist of input amplifiers, resistant to overdriving, with descriminators, special proportional counters with $\alpha/\beta$ windows of 100 $cm^2$, 1 $mg/cm^2$ weight per unit area and are equippped with electric cable connections with counting gas passage. The circular meters, PZ 15, PZ 40, and the flat meter, PZ 50, for the inside diameter $>15$, $>40$, $>90$ mm are available for measuring of extremely bent surfaces with optimum counting efficiencies. The flat meter, Pz 50, can also be used as a detector block, in a multiple arrangement, for extensive surface contamination measurements of externally contaminated pipes, in the case of large quantities in automatic measuring equipment.

7340 (INIS-mf—9071, pp 15) **Optional way to calibrate the accuracy of a number of gamma dosemeters.** Gaspar, J.; Palko, L. (MN Vegyivedelmi Anyagellato Koezpont, Budapest (Hungary)); Stenger, V. (Magyar Tudomanyos Akademia, Budapest. Izotopintezete); Lenart, A. (Orszagos Meresuegyi Hivatal, Budapest (Hungary)). 1984. (In Hungarian). NTIS (US Sales Only), PC A04/MF A01. File Number TI85780132. (CONF-8404195—Summ.).

From Training course on radiation protection; Balatonkenese, Hungary (11 Apr 1984).

7341 (INIS-mf—9071, pp 18) **Development of the dosemeter PILLE NA-206 for spacecraft use.** Feher, I.; Szabo, B.; Vagvoelgyi, J.; Deme, S.; Szabo, P.P.; Csoeke, A. (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). 1984. (In Hungarian). NTIS (US Sales Only), PC A04/MF A01. File Number TI85780132. (CONF-8404195—Summ.).

From Training course on radiation protection; Balatonkenese, Hungary (11 Apr 1984).

7342 (INIS-mf—9071, pp 22) **Selective measurement of accidental neutron and gamma doses by means of an $Al_2O_3$ TL dosemeter.** Osvay, M. (Magyar Tudomanyos Akademia, Budapest. Izotopintezete); Ranogajec-Komor, M. (Institut Rudjer Boskovic, Zagreb (Yugoslavia)). 1984. (In Hungarian). NTIS (US Sales Only), PC A04/MF A01. File Number TI85780132. (CONF-8404195—Summ.).

From Training course on radiation protection; Balatonkenese, Hungary (11 Apr 1984).

7343 (INIS-mf—9071, pp 24) **Development of a plastic track detector of high sensitivity for neutron dosimetric and spectrometric purposes.** Somogyi, G. (Magyar Tudomanyos Akademia, Debrecen. Atommag Kutato Intezete). 1984. (In Hungarian). NTIS (US Sales Only), PC A04/MF A01. File Number TI85780132. (CONF-8404195—Summ.).

From Training course on radiation protection; Balatonkenese, Hungary (11 Apr 1984).

7344 (INIS-mf—9071, pp 17) **Calibration problems of an equipment detecting thoron exhalation.** Toth, A. (Baranya Megyei Korhaz-Rendeloeintezet, Pecs (Hungary). Koezponti Lab.); Hermann, A. (VIDEOTON Fejlesztesi Intezet, Budapest (Hungary)). 1984. (In Hungarian). NTIS (US Sales Only), PC A04/MF A01. File Number TI85780132. (CONF-8404195—Summ.).

From Training course on radiation protection; Balatonkenese, Hungary (11 Apr 1984).

7345 (INIS-mf—9073) **Computer program for the construction of the level scheme on the basis of energy-balance of gamma transitions.** Ditroi, F.; Mahunka, I. (Magyar Tudomanyos Akademia, Debrecen. Atommag Kutato Intezete). Mar 1984. 15p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85780130.

A computerized method is presented for the construction of the level scheme on the basis of measured energies of the gamma-transitions without any previous knowledge of the observed isotope. The method and the main steps of the algorithm are discussed. The two parts of the program are called SEMA-1 and SEMA-2, resp. The calculated results are compared with the published schemes for the given isotopes.

7346 (Juel-Spez—255, pp 136-138) **Compton suppression array for high resolution in-beam spectroscopy.** Lieder, R.M.; Gast, W.; Jaeger, H.; Schaeffler-Kraeh, J.; Maier, K.H.; Brentano, P. v.; Eberth, J.; Schiffer, K.; Huebel, H.; Blume, K.P. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

7347 (Juel-Spez—255, pp 139) **Magnet spectrometer BIG KARL.** Berg, G.P.A.; Brinkmoeller, B.; Hlawatsch, G.; Magiera, A.; Meissburger, J.; Paul, D.; Prasuhn, D.; Roemer, J.G.M.; Rossen, P. von; Schult, O. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

7348 (Juel-Spez—255, pp 139) **Spectrometer control.** Brinkmoeller, B.; Kruck, K.; Meissburger, J. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

7349 **(KFK—3734) Control program of the neutron four-circle-diffractometer P110 at the ORPHEE reactor/CEN Saclay.** Guth, H.; Paulus, H.; Reimers, W.; Heger, G. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Angewandte Kernphysik 1). May 1984. 103p. (In English.). NTIS (US Sales Only), PC A06/MF A01. File Number DE84752289.

The four-circle diffractometer P110 for elastic neutron scattering on single crystals was installed at the ORPHEE reactor/CEN Saclay in 1982. The control progam, presented here, is a new update of the former program versions used at the FR2 reactor. Important improvements concerning reliability and handling of the diffractometer are added.

7350 **(ORNL/TM—9077) ORNL Pocket Meter Program: internal operating procedures.** Berger, C.D.; Miller, J.H.; Dunsmore, M.R. (Oak Ridge National Lab., TN (USA)). Dec 1984. Contract AC05-84OR21400. 22p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85003790.

The ORNL Pocket Meter Program is designed for auditing the approximate photon radiation exposure of Oak Ridge National Laboratory (ORNL) radiation workers. Although pocket meters are considered to be a secondary personnel dosimetry system at ORNL, they are valuable indicators of unplanned exposures if proper procedures are followed for testing, calibrating, deploying, wearing, processing, and recording data. 4 figures, 1 table.

7351 **High-purity germanium crystal growing.** Hansen, W.L.; Haller, E.E. (Lawrence Berkeley Lab., CA). *Materials Research Society Symposia Proceedings;* **16**: 1-16(1983). Contract AC03-76SF00098.

The germanium crystals used for the fabrication of nuclear radiation detectors are required to have a purity and crystalline perfection which is unsurpassed by any other solid material. These crystals should not have a net electrically active impurity concentration greater than $10^{10}cm^{-3}$ and be essentially free of charge trapping defects. Such perfect crystals of germanium can be grown only because of the highly favorable chemical and physical properties of this element. However, ten years of laboratory scale and commercial experience has still not made the production of such crystals routine. The origin and control of many impurities and electrically active defect complexes is now fairly well understood but regular production is often interrupted for long periods due to the difficulty of achieving the required high purity or to charge trapping in detectors made from crystals seemingly grown under the required conditions. The compromises involved in the selection of zone refining and crystal grower parts and ambients is discussed and the difficulty in controlling the purity of key elements in the process is emphasized. The consequences of growing in a hydrogen ambient are discussed in detail and it is shown how complexes of neutral defects produce electrically active centers.

7352 **Silicon radiation detectors - materials and applications.** Walton, J.T.; Haller, E.E. (Lawrence Berkeley Lab., CA). *Materials Research Society Symposia Proceedings;* **16**: 141-160(1983). Contract AC03-76SF00098.

Silicon nuclear radiation detectors are available today in a large variety of sizes and types. This profusion has been made possible by the ever increasing quality and diameter silicon single crystals, new processing technologies and techniques, and innovative detector design. The salient characteristics of the four basic detector groups, diffused junction, ion implanted, surface barrier, and lithium drift are reviewed along with the silicon crystal requirements. Results of crystal imperfection detected by lithium ion compensation are presented. Processing technologies and techniques are described. Two recent novel position-sensitive detector designs are discussed - one in high-energy particle track reconstruction and the other in 2-ray angiography. The unique experimental results obtained with these devices are presented.

## 4402 Radiation Effects On Instrument Components, Instruments, Or Electronic Systems

7353 **(HMI-B—398) Oxide charge build-up in MOS-structures by tunnel-injection and irradiation.** Knoll, M. (Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (Germany, F.R.). Bereich Datenverarbeitung und Elektronik; Technische Univ. Berlin (Germany, F.R.). Fachbereich 19 - Elektrotechnik). Aug 1983. 131p. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number DE84752307.

Tunnel injection and irradiation experiments on MOS structures are performed in order to compare the effects of the two procedures. A model of oxide charge build-up by tunnel injection is established which yields figures of the electron capture cross section, the detrapping cross section and the impact ionizing coefficient. The interface charge is neutral for midgap band bending and the interface states have acceptor type above and donor type below midgap.

## 4403 Miscellaneous Instruments

7354 **(DOE/ER/12054—2) Computerized underground image reconstruction. Final report, July 15, 1982-July 14, 1984.** Dines, K.A. (XDATA Corp., Indianapolis, IN (USA)). Sep 1984. Contract AC02-82ER12054. 49p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85003620.

The development of tomographic reconstruction techniques for application to underground imaging is described. Results from two areas of investigation are summarized: (1) implementation of software for field application of transmission tomography using cross-borehole measurements; and (2) feasibility research on the application of reflection tomography to underground imaging using linear array surface probing. The imaging methodologies described are applicable to electromagnetic and seismic transmission or reflection data measured as line-integrals of electrical and acoustic properties in planar underground cross sections. Software was designed, implemented, and tested for a field-deployable, microcomputer-based, transmission tomographic imaging system. The field system provides the unique ability to reconstruct two-dimensional images of electromagnetic attenuation throughout the plane bounded by two boreholes. The system configuration and software are documented here. Also research results are presented on the investigation of computed reflection tomography for application to underground imaging. The imaging technique is based on a line-integral measurement model for incoherent acoustic backscattering from elliptical integration paths through a two-dimensional underground cross section. Computer simulation results are presented illustrating the image quality obtainable for the case of a linear surface array of sources and receivers. Test results include images of layered structures, lines, and point reflectors obtained by an iterative reconstruction technique applied to simulated data. The method is aimed at near surface imaging situations in which high resolution is required for the detection of buried objects, fractures or other significant scattering features.

7355 (INIS-mf—9098, pp 59-60) **Recent advance in on-stream analysis equipment for mineral concentrations and metal refineries.** Saarhelo, K. (Outokumpu Oy, Finland); Barker, D.R. (Bateman Process Instrumentation, South Africa). 1984. NTIS (US Sales Only), PC A08/MF A01. File Number TI85780156. (CONF-8403156—Absts.).

From MINTEK 50: international conference on recent advances in mineral science and technology; Sandton, South Africa (26 Mar 1984).

7356 (INIS-mf—9098, pp 57-58) **Recent advances in on-stream analysis equipment.** Toop, A.; Wilkinson, L.R.; Wenk, G.J. (The Australian Mineral Development Laboratories, Australia). 1984. NTIS (US Sales Only), PC A08/MF A01. File Number TI85780156. (CONF-8403156—Absts.).

From MINTEK 50: international conference on recent advances in mineral science and technology; Sandton, South Africa (26 Mar 1984).

7357 **Instrumentation at the National Center for Electron Microscopy: the Atomic Resolution Microscope.** Gronsky, R.; Thomas, G. (Lawrence Berkeley Lab., CA). *Proceedings - Annual Meeting, Electron Microsopy Society of America;* **41**: 310-311(1983).

The Atomic Resolution Microscope (ARM) is one of two unique high voltage electron microscopes at the Lawrence Berkeley Laboratory's National Center for Electron Microscopy (NCEM). The latest results from this new instrument which was manufactured by JEOL, Ltd. to the performance specifications of the NCEM, delivered in January of 1983, and soon to be open to access by the entire microscopy community are given. Details of its history and development are given and its performance specifications are reviewed.

### 4404 Well Logging Instrumentation

7358 **(LA-tr—84-47) NGS-1 well neutron impulse generator.** Dzhemilev, R.A. Translated from *Geofizicheskaya Apparatura ;* No. 46, 58-63(1971). Contract W-7405-ENG-36. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85000251. DE85000251

The NGS-1 apparatus consists of three basic blocks: a control panel, a well device (generator and recording devices) and a frequency and supply voltage transformer. The well equipment of the NGS-1 is an impulse low frequency neutron generator with detachable generator blocks (for NT-10 and NT-16 tubes) and a two channel radiometer with detachable scintillation neutron or gamma-radiation counters.

## 45 EXPLOSIONS AND EXPLOSIVES

### 4501 Chemical

*REFER ALSO TO CITATION(S) 4501007299*

7359 **(UCID—20277) Thermodynamics of the reactive flow model.** Nutt, G.L. (Lawrence Livermore National Lab., CA (USA)). 14 Nov 1984. Contract W-7405-ENG-48. 15p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85004405.

The explosive is assumed to undergo a hydrodynamic shock which initiates the chemical decomposition into product gases. The resulting fluid is regarded as two separate phases (reactant and product) at a common pressure. A reactive flow model is constructed which can be substituted for an equation of state subroutine in a hydrodynamic computer code. (DLC)

7360 (UCRL—52000-84-10, pp 24-32) **Supracompression of high-explosive detonation products.** Oct 1984. NTIS, PC A03/MF A01. File Number TI85003245.

In Energy and Technology Review.

The results of new, high-precision experiments with our light-gas gun, in which the detonation products of high explosives are driven to compression states considerably higher those reached in planar detonations, have forced us to reexamine our treatment of the equation of state for high-explosive detonation products and have revealed ways in which it was inadequate. This finding poses a troubling dilemma concerning the Chapman-Jouguet model for the detonation state. There appears to be a systematic difference between impactor-supported and self-supported detonation waves, the nature of which is still under investigation.

### 4502 Nuclear

7361 **(AD-A—144998/2) Equalization of time-varying dispersive channels via sequence estimation. Technical report.** Ibaraki, R.; Tsui, E.; Hawker, J. (ESL, Inc., Sunnyvale, CA (USA)). 13 Jul 1983. 72p. (ESL-TM—1642). NTIS, PC A04/MF A01.

Adaptive maximum likelihood sequence estimation (AMLSE) has been shown to be an effective mitigation technique for high data rate links against the deleterious effects of intersymbol interference resulting from rapidly time-varying and frequency selective fading channels. It was demonstrated that significant performance improvements can be obtained through the use of AMLSE receiver demodulation in comparison to conventional (non-delay spread specialized) receivers and even decision feedback equalization receivers. In addition, several important channel related receiver anomalies which introduce symbol timing ambiguities were identified.

## 50 ENVIRONMENTAL SCIENCES, ATMOSPHERIC

### 5001 Basic Studies

7362 (INIS-mf—9071, pp 57) **Calibration of the particle size classification method for environmental aerosols.** Maschek, I.; Csepregi, T. (Orszagos Frederic Joliot-Curie Sugarbiologiai es Sugaregeszseguegyi Kutato Intezet, Budapest (Hungary)); Formignani, M. (Ente Nationale per l'Energia Elettrica, Bologna (Italy). Centro Studi e Ricerche). 1984. (In Hungarian). NTIS (US Sales Only), PC A04/MF A01. File Number TI85780132. (CONF-8404195—Summ.).

From Training course on radiation protection; Balatonkenese, Hungary (11 Apr 1984).

7363 **(KFK—3565) Investigation of meso-scale atmospheric transport phenomena in the environment of the Karlsruhe Nuclear Research Center by use of radar-tracked tetroons.** Vogt, S.; Thomas, P. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Hauptabteilung Sicherheit). May 1984. 76p. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE84752331.

In the Upper Rhine Valley near the Karlsruhe Nuclear Research Center 19 tetroons were tracked by radar during the years 1978, 1980 and 1982. The mean flight levels of the tetroons varied between 300 m and 1000 m, the maximum range of tracking extended up to 83 km. Some of the tetroons had been equipped with transponders. During the measuring campaigns additional meteorological data were supplied by the 200 m high meteorological tower erected on the site of the Nuclear Research Center, by a Doppler sodar and by radiosondes. The measured values received from the radar are used to calculate the trajectories of the tetroons. They are represented as profiles and in horizontal projections. The measured trajectories are compared with calculated ones. The latter have been derived from various models and a number of meteorological data measured at fixed locations. The trajectories are the basis for calculating horizontal dispersion parameters which are compared with results of own tracer experiments.

7364 **(LA-UR—84-3447) Structure and forcing of teleconnection patterns occurring in general circulation model simulations.** Malone, R.C.; Pitcher, E.J.; Blackmon, M.L.; Geisler, J.E. (Los Alamos National Lab., NM (USA); Miami Univ., FL (USA); National Center for Atmospheric Research, Boulder, CO (USA); Utah Univ., Salt Lake City (USA)). 1984. Contract W-7405-ENG-36. 3p. (CONF-850132—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE85002434.

From 3. conference on climate variations; Los Angeles, CA, USA (8 Jan 1985).

Several characteristics of teleconnection-pattern fluctuations occurring in general circulation model (GCM) simulations were examined. The model used is the NCAR Community Climate Model. 7 references, 3 figures. (ACR)

7365 **(RFP—3730) Model for asymmetrical plume growth and dispersion in complex terrain.** Hodgin, C.R. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 1984. Contract AC04-76DP03533. 5p. (CONF-841059—13). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003213.

From 3. American Meteorological Society conference on mountain meteorology; Portland, OR, USA (15 Oct 1984).

A generalized ellipsoidal puff model designed for use in complex terrain has been developed at the Rocky Flats Plant. This paper discusses the model's scheme for determining puff growth and shape. Each puff is defined by six tracer particles. The particles define the edges of the puff (+/- $3\sigma$) along each of the axes. The particles are advected through a three-dimensional windfield which includes the complex terrain effects of advection, vertical shear, horizontal divergence and convergence, and lofting. The puff axes are not constrained to be orthogonal; thus, the puff assumes an arbitrary shape in response to varying flow and dispersion conditions throughout its volume. 11 references, 2 figures.

7366 **(UCID—20227) Portable Automated Mesonet (PAM) data from the 1980 experiment in Anderson Creek Valley.** Nappo, C.J.; Satterfield, L.C. (National Oceanic and Atmospheric Administration, Oak Ridge, TN (USA). Atmospheric Turbulence and Diffusion Lab.). Aug 1984. Contract W-7405-ENG-48. 935p. (ASCOT—84-4). NTIS, PC A99/MF A01; 1; GPO Dep. File Number DE85004361.

During the 1980 ASCOT field study in Anderson Creek Valley, CA, the National Center for Atmospheric Research operated its Portable Automated Mesonet (PAM) system from 9 to 25 September. These data provide continuous measurements of surface-layer winds, temperature, atmospheric pressures, and relative humidities at 27 stations. Wind speed and direction were measured at 4 m (AGL), and temperature, pressure and relative humidity were measured at 2 m (AGL). Observation sampling rate was 1 Hz, and these values were processed into one-minute averages which are stored on magnetic tape. The one-minute average wind direction was calculated as the prevailing wind direction, i.e., the direction of the one-minute averaged wind vector. The data are organized by day and station. In order to simplify examination, the observation periods are divided into daytime (0600 to 2100 LST) and nighttime (1800 to 0900 LST) segments. The data have been edited to remove obvious outliers. The plots are constructed from the one-minute observations. Empty spaces or graphs represent missing or unacceptable data.

7367 **Kinematics and correlation of the surface wind field in the South Atlantic Bight.** Weisberg, R.H.; Pietrafesa, L.J. (North Carolina State Univ., Raleigh). *Journal of Geophysical Research;* **88**: No. C8, 4593-4610(30 May 1983).

Surface winds observed at Charleston, South Carolina, and at an offshore buoy located some 300 km to the east of Charleston are analyzed to determine operational transformations for estimating the offshore winds from the coastal winds. Both the statistics describing the wind field at each station along with those describing the correlation between stations are found to be seasonally modulated. Ensemble averaged (by season) transfer functions computed by using the first 3 years of available data are applied to a fourth independent data year for assessing their predictive utility. The transfer functions and predictability are both seasonally modulated and the transformation matrix is nondiagonal (each offshore wind velocity component depends upon both coastal components).

## 5002 Chemicals Monitoring And Transport

*REFER ALSO TO CITATION(S) 5002006318, 6328, 6330, 6714, 6977, 6987, 6990, 7251, 7389, 7399, 7400, 7517, 7518*

7368 **(BNL—35030) Effects of acid deposition on materials and cultural resources.** Sherwood, S.; Lipfert, F.W. (Brookhaven National Lab., Upton, NY (USA); National Park Service, Washington, DC (USA)). 10 Apr 1984. Contract AC02-76CH00016. 28p. (CONF-8404112—1). NTIS, PC A03/MF A01; GPO Dep. File Number DE85003605.

From Acid rain--a New York State agenda; Albany, NY, USA (10 Apr 1984).

An assessment is presented of the state of knowledge and research needs for materials damage due to air pollution and acidic (wet) deposition. The perspective chosen is that of New York State, and the emphasis is on the quantification of damages to both common construction materials and to cultural resources. 5 figures.

7369 **(BNL—35223) Oxidants and acid precipitation: a method for identifying and modeling effects on United States soybean yield.** Medeiros, W.H.; Moskowitz, P.D.; Coveney, E.A.; Thode, H.C. Jr. (Brookhaven National Lab., Upton, NY (USA)). 1983. Contract AC02-76CH00016. 10p. (CONF-830617—16). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003604.

From 76. annual meeting of the Air Pollution Control Association; Atlanta, GA, USA (19 Jun 1983).

Results are presented of cross-sectional analyses which examine effects of two regional-level pollutants (oxidants and acid rain) and regionally varying climatic and edaphic factors on yield of soybeans. Resuslts of these analyses were used to assess effects of oxidant and acid rain control strategies in US soybean yield. 17 references, 2 tables. (ACR)

7370 **(CONF-850115—3) Are stringent emission standards for heavy-duty trucks worth the cost.** Saricks, C.L.; Singh, M.K. (Argonne National Lab., IL (USA)). 8 Aug 1984. Contract W-31-109-ENG-38. 37p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85003033.

From 64. annual Transportation Research Board meeting; Washington, DC, USA (21 Jan 1985).

This paper is based on a study sponsored at Argonne National Laboratory (ANL) by the Department of Energy Office of Environmental Analyses that investigated the costs, benefits, and cost-effectiveness of requiring heavy-duty trucks to meet gaseous and particulate emission standards suggested or proposed by EPA in 1981. There remains considerable disagreement between EPA and engine and truck manufacturers regarding both the feasibility and expenditure required to achieve these standards. Moreover, EPA apparently did not include explicit computation of fuel economy losses in its draft regulatory analyses. The resulting incremental costs presumably passed on to truck buyers both at time of sale and during the vehicle's lifetime could be considerable. The greatest variation in cost estimates is found with respect to implementing trap oxidizer technology for heavy-duty diesel particulate control. Although the ANL study arrived at a quantitative estimate of cost-effectiveness in dollars per tons of pollutant removed, the values are distributed over a wide range reflecting the continuing unresolved disagreements in control costs. The study also focused more specifically (beyond total tons removed) on the likely air quality benefits of the suggested standards in a case-study urban area with a history of nonattainment problems. While the proposed NO/sub x/ standard would result in a 45% reduction in total NO/sub x/ loading as compared to what would occur under the current standard, the corresponding reduction of short-term $NO_2$ exposure in prototypical urban corridors of high heavy-truck VMT would not exceed 35%. The resulting health benefits are unknown. 36 references, 6 figures, 13 tables.

**7371 (DOE/ER/60044—1) Method for continuous records of the pH of low-level clouds. Final report.** Black, H.D.; Landsberg, H.E. (Maryland Univ., College Park (USA). Dept. of Meteorology). 31 Aug 1983. Contract AS05-82ER60044. 34p. NTIS, PC AA03/MF A01; GPO Dep. File Number DE85002981.

A redesigned automatic pH measuring fog interceptor was installed during June to August at 1000 meters elevation in the Blue Ridge Mountains of Virginia, together with an automatic weather station. A detailed description of the equipment is given. It recorded four events. Two were short-lived radiation fogs which had pH of around 6.7. Two other events were post-frontal, non-precipitating low-level clouds. Their pH was also near neutral, although a bulk sample showed a pH of 5.5. In the latter case the 24-hour trajectory indicated an orgin of the air mass in the Great Lake region. All the other cases showed trajectories suggesting local origin rather thhan advection of air. The pH values which are higher than most reported in the literature, especially from the Adirondacks, are ascribed to possible incorporation of the locally abundant limestone dust into the droplets. 22 references, 7 figures, 2 tables.

**7372 (DOE/PC/61252—T1) Meteorological support for the 1983 Deep Creek, Maryland experiment. Final report, 18 July 1983-31 March 1984.** Samson, P.J.; Fernau, M.E.; Masters, J.M.; Johnson, D.A. (Michigan Univ., Ann Arbor (USA). Dept. of Atmospheric and Oceanic Science). 1984. Contract FG22-83PC61252. 152p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE85002616.

Plume studies have been performed on the transport, transformation, and dispersion of nitric acid, nitrates, and ammonia in the first hours of emission. The study reported on here was performed at Deep Creek, Maryland during August, 1983. Nitric acid levels in the aerosol seem to be high if upper air flow is from the west or northwest, as long as the air had long residence times over the Ohio, Kentucky, Indiana or Michigan areas. Some exceptions to this were seen. Flow from the northeast was associated with lower values of nitric acid, even if the air stagnated over the area to the immediate east or northeast of Deep Creek. Surface trajectories support the above conclusions for the most part, although contradictions do appear. There also appears to be a correlation between rain events and a subsequent lowering of nitric acid levels. Absolute concentrations of particulte nitrate were generally low during the first half of the month and high the second half of the month. This dichotomy is not obviously related to a major shift in wind patterns over the month. The lowest values of all four components generally occurred with transport from the northeast or east or with high wind speeds. The pattern for highest values is not as clear although low wind speeds from the west are often associated with high values.

**7373 (ORNL/CSD—94) Atmospheric Transport Model for toxic substances (ATM-TOX).** Raridon, R.J.; Murphy, B.D.; Culkowski, W.M.; Patterson, M.R. (Oak Ridge National Lab., TN (USA)). Nov 1984. Contract AC05-84OR21400. 115p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE85003596.

An updated version of the Atmospheric Transport Model includes a wind profile, afternoon and nocturnal mixing heights, and first-order degradation of the airborne species. The previous version included the effect of aerodynamic roughness on dispersion constants, terminal and deposition velocities, plume tilting for heavy particles, and an episodic calculation of exposure maxima. The model calculates atmospheric concentration for both wetfall and dryfall. Sample input and output demonstrate the use of the model. 44 references, 7 figures.

**7374 Reduction of sulfur dioxide by $Cp_2MH_2$ (M = Mo, W) to $Cp_2M(S_2O_3)$ and water: molecular structure and reaction with acids of an organometallic molybdenum-thiosulfate complex.** Kubas, G.J.; Ryan, R.R. (Los Alamos National Lab., NM). *Inorganic Chemistry;* **23**: No. 20, 3181-3183(26 Sep 1984).

Treatment of $Cp_2MH_2$ (M = No, W) solutions with $SO_2$ has been found to rapidly and quantitatively give $Cp_2M(S_2O_3)$ and water. Single-crystal X-ray studies of the Mo product at -95°C revealed bidentate coordination of thiosulfate to molybdenum [Mo-O = 2.134 (4) A; Mo-S = 2.450 (2) A] with a dihedral angle between the Cp planes of 46.8° and a planar $MoOS_2$ ring. The thiosulfate complexes were found to react with aqueous HCl and HBr to produce $SO_2$, $H_2O$, and new metal-sulfur complexes of apparent stoichiometry $[Cp_2M(S)(X)]X$ (X = Cl, Br), characterized by infrared and proton NMR spectroscopy. Crystallographic data for $Cp_2Mo(S_2O_3)$ are presented.

**7375 Oxidant and acid precipitation effects on soybean yield: cross-sectional model development.** Medeiros, W.H.; Moskowitz, P.D.; Coveney, E.A.; Thode, H.C. Jr.; Oden, N.L. (Brookhaven National Laboratory, Upton, NY). *Environment International;* **10**: No. 1, 27-33(1984).

Regression models have been constructed to examine effects of oxidant and acid precipitation air pollutants and regional factors on soybean yield. Although regional factors provide most of the explanatory power, effects of oxidants and acid precipitation are statistically significant. These regressions suggest that controlling oxidant air pollution may produce greater benefit than controlling acid precipitation. Specifically, controlling pH to 5.2 or 5.6 would result in a national-level increase in soybean yield of ~ 1%. In comparison, if oxidant concentrations were controlled to 40 or 25 ppb (nL/L), a national-level increase of 4%-9% is predicted. Simultaneous control of both pollutants (i.e., pH = 5.6, oxidant = 25 ppb (nL/L)) would result in a national-level benefit of ~ 10%. Regression models and field generated dose-response functions predict similar results. Before the methods developed in this paper can be used for policy analysis, data and sources of estimate uncertainity need to be more closely examined. 27 references, 2 figures, 3 tables.

**7376 Chemical and physical analyses of Houston aerosol for interlaboratory comparison of source apportionment procedures.** Johnson, D.L.; Davis, B.L.; Dzubay, T.G.; Hasan, H.; Crutcher, E.R.; Courtney, W.J.; Jaklevic, J.M.; Thompson, A.C.; Hopke, P.K. (State Univ. of New York, Syracuse). *Atmospheric Environment;* **18**: No. 8, 1539-1553(1984).

Eighteen consecutive 12-h ambient aerosol samples were obtained in Houston, TX, as part of a US Environmental Protection Agency visibility study in that city. The samples were collected on Teflon, Nuclepore and quartz filters by means of dichotomous samplers and were analyzed for mass, elemental and ionic species concentrations by $\beta$-ray attenuation, X-ray fluorescence, ion chromatography, colorimetry, instrumental neutron activation analysis and pyrolysis. The specimens and analytical data were distributed to participants of the Mathematical and Empirical Receptor Models Workshop (Quail Roost II), to provide a basis for comparison of source apportionment procedures. Certain workshop participants undertook further analyses of the specimens by X-ray powder diffraction, scanning electron microscopy with automated image analysis and X-ray energy spectroscopy, and analytical light microscopy. This report describes all of these analytical procedures. Also, through prototype comparison mechanisms, the elemental, compound and individual particle data are reduced to a common basis (elemental composition), permitting intercomparisons of results from different methods. In general, the intercomparisons suggest that each analytical technique has certain advantages and limitations for receptor modeling and that the various techniques are best viewed as complimentary.

**7377 Clean Air Act reauthorization (part 2). Hearing before the Subcommittee on Health and the Environment of the Committee on Energy and Commerce, House of Representatives, Ninety-Eighth Congress, Second Session on H.R. 3400 and H.R. 5084, March 22, 1984.** Washington, DC, USA; Government Printing Office (1984). 985p.

Part 2 of the hearing record covers the second day of testimony on H.R. 3400 and H.R. 5084 that amend the Clean Air Act, the first to control specified sulfur dioxide and nitrogen oxide sources to reduce acid deposition and the second to control hazardous air pollutants from all sources in the interest of public health. The witnesses spoke for the auto and truck industry, environmental research organizations, environmental and citizen groups, chemical manufacturers, the health professions, elected officials, and others. Additional material submitted for the record follows the text of the two bills and the testimony of 19 witnesses.

7378 **Characteristics of oxidant precursor emissions from anthropogenic sources in the US.** Benkovitz, C.M. (Brookhaven National Lab., Upton, NY). *Environment International;* 9: No. 6, 429-445(1983). Contract AC02-76CH00016.

Hydrocarbons (HC) and nitrogen oxides (NO/sub x/) have been identified as the most important precursor pollutants for oxidant formation in the atmosphere. These pollutants are emitted both from natural and anthropogenic sources; however, these two types of sources are generally geographically separated. Anthropogenic emissions are dominant in and around urban centers, where the majority of severe oxidant problems occur. Based on data gathered by the MAP3S/RAINE emissions inventory project, anthropogenic emissions of HC in the conterminous US were 24.8 metric tons in 1979. HC emissions were predominantly from area sources, the transportation sector being the largest contributor with 39.8% of the total. State-by-state breakdowns are also included. Based on analyses by other emissions inventory projects, the nonreactive fraction of the emissions from the transportation sector is less than 20% by weight. The highest proportion of HC emissions occur at low altitudes (0-50 m range) in high population density areas. Anthropogenic emissions of NO/sub x/ were 23.7 million metric tons in 1979; 50.8% were from point sources. The transportation sector and the electric utilities sector account for 37.1% and 30.9% of the NO/sub x/ emissions, respectively. The $NO_2$ fraction of the emissions from the transportation and electric utilities sectors is less than 10% by weight, based on $NO/NO_2$ speciation data from two other emissions inventories. Highest rates of NO/sub x/ emissions occur in high population density areas and are released at low altitude (0-50 m); three areas of high electric generating capacity were found to have high release altitudes.

7379 **Pseudo-spectral technique in the computation of seasonal average concentrations and its comparison with the trajectory technique.** Murphy, B.D. (Oak Ridge National Lab., TN). pp 285-301 of Air pollution modeling and its application. II. De Wispelaere, C. (ed.). New York, NY, USA; Plenum Publishing Corporation (1983). Contract W-7405-ENG-26.

A pseudo-spectral code for dealing with multiple source assessment problems involving atmospheric transport over continental scale distances and which uses readily available upper-air wind data is described. The code is compared with a trajectory code which also uses the same upper-air data to interpolate trajectory segments.

## 5003 Radioactive Materials Monitoring And Transport

*REFER ALSO TO CITATION(S) 5003006500, 6527, 6529, 7389*

7380 (INIS-mf—9071, pp 53) **Application of ion exchange analytical procedures in the environmental radiation protection.** Varteresz, V.; Stur, D. (Orszagos Frederic Joliot-Curie Sugarbiologiai es Sugaregeszseguegyi Kutato Intezet, Budapest (Hungary)). 1984. (In Hungarian). NTIS (US Sales Only), PC A04/MF A01. File Number TI85780132. (CONF-8404195—Summ.).

From Training course on radiation protection; Balatonkenese, Hungary (11 Apr 1984).

7381 (INIS-mf—9071, pp 27) **Measurement of the atmospheric tritium contamination at the PAKS Nuclear Power Plant.** Uchrin, G.; Daboczy, I. (Magyar Tudomanyos Akademia, Budapest. Izotopintezete); Ormai, P. (Paksi Atomeroemue Vallalat (Hungary)). 1984. (In Hungarian). NTIS (US Sales Only), PC A04/MF A01. File Number TI85780132. (CONF-8404195—Summ.).

From Training course on radiation protection; Balatonkenese, Hungary (11 Apr 1984).

7382 **(NUREG/CR—4014) Laboratory measurements of parameters affecting wet deposition of methyl iodide.** Maeck, W.J.; Honkus, R.J.; Keller, J.H.; Voilleque, P.G. (Westinghouse Idaho Nuclear Co., Inc., Idaho Falls (USA); Science Applications, Inc., Idaho Falls, ID (USA)). Sep 1984. Contract AC07-84ID12435. 52p. (WINCO—1023). NTIS, PC A04/MF A01 - GPO. File Number TI85003688.

The transfer of gaseous methyl iodide ($CH_3I$) to raindrops and the initial retention by vegetation of $CH_3I$ in raindrops have been studied in a laboratory experimental program. The measured air-to-drop transfer parameters and initial retention factors both affect the wet deposition of methyl iodide onto vegetation. No large effects on the air-to-drop transfer due to methyl iodide concentration, temperature, acidity, or rain type were observed. Differences between laboratory measurements and theoretical values of the mass transfer coefficient were found. Pasture grass, lettuce, and alfalfa were used to study the initial retention of methyl iodide by vegetation. Only a small fraction of the incident $CH_3I$ in raindrops was held by any of the three vegetation types.

7383 **(PNL-SA—12395) Ambient krypton-85 air sampling at Hanford.** Trevathan, M.S.; Price, K.R. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1984. Contract AC06-76RL01830. 10p. (CONF-841187—8). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003602.

From 5. DOE environmental protection information meeting; Albuquerque, NM, USA (6 Nov 1984).

In the fall of 1982, the Environmental Evaluations Section of Pacific Northwest Laboratory (PNL) initiated a network of continuous krypton-85 air samplers located on and around the Hanford Site. This effort was in response to the resumption of operations at a nuclear fuel reprocessing plant located onsite where krypton-85 was to be released during fuel dissolution. Preoperational data were collected using noble gas samplers designed by the Environmental Protection Agency-Las Vegas (EPA-LV). The samplers functioned erratically resulting in excessive maintenance costs and prompted a search for a new sampling system. State of the art krypton-85 sampling methods were reviewed and found to be too costly, too complex and inappropriate for field application, so a simple bag collection system was designed and field tested. The system is composed of a reinforced, heavy plastic bag, connected to a variable flow pump and housed in a weatherproof enclosure. At the end of the four week sampling period the air in the bag is transferred by a compressor into a pressure tank for easy transport to the laboratory for analysis. After several months of operation, the air sampling system has proven its reliability and sensitivity to ambient levels of krypton-85. 3 references, 3 figures, 1 table.

7384 **(WINCO—1002-Suppl.1-10-84) ICPP third quarter 1984 effluent monitoring report.** (Westinghouse Idaho Nuclear Co., Inc., Idaho Falls (USA)). Oct 1984. Contract AC07-84ID12435. 63p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85003462.

This report summarizes the data collected by effluent and environmental monitoring programs conducted at the Idaho Chemical Processing Plant by the Environmental Engineering Subsection. The period covered by this report is from June 20, 1984 through September 19, 1984. During the third quarter of 1984, 2.60E+02 curies of activity were released from ICPP operations. Airborne effluent releases to the atmosphere contributed approximately 2.89E+01 curies; liquid effluent releases to the Percolation Pond contributed 1.40E+00 curies; and solid waste shipped to the Radioactive Waste Management Complex (RWMC) contained 2.30E+02 curies. 27 figures, 13 tables.

### 5006 Regulations

*REFER ALSO TO CITATION(S) 5006007377*

7385 **Clean Air Act Reauthorization (Part 3). Hearings before the Subcommittee on Health and the Environment of the Committee on Energy and Commerce, House of Representatives, Ninety-Eighth Congress, Second Session on H.R. 3400 and H.R. 5084, March 29, 30, 1984.** Washington, DC, USA; Government Printing Office (1984). 867p.

Part 3 of the hearing record covers two days of hearings on two amendments to the Clean Air Act (H.R. 3400 and H.R. 5084). Major witnesses were Energy Secretary Hodel and Environmental Protection Agency (EPA) Administrator Ruckelshaus. Other witnesses included Louis Harris, reporting a high percentage of public support for restoring air quality, and representatives of various industries affected by EPA regulations. Among the topics covered were the control of toxic pollutants and acid rain, which the administration wants to limit to research only. Hodel and Ruckelshaus reviewed administration positions, while industry spokesmen raised questions about regional differences, costs, potential environmental benefits, and the impact on employment. Additional material submitted for the record follows the testimony of 22 witnesses.

## 51 ENVIRONMENTAL SCIENCES, TERRESTRIAL

### 5101 Basic Studies

*REFER ALSO TO CITATION(S) 5101008088*

### 5102 Chemicals Monitoring And Transport

*REFER ALSO TO CITATION(S) 5102007389*

7386 **(EPRI-EA—3417-Vol.2) Geohydrochemical models for solute migration. Volume 2. Preliminary evaluation of selected computer codes. Final report.** Kincaid, C.T.; Morrey, J.R. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Nov 1984. Contract AC06-76RL01830. 338p. NTIS, PC A15/MF A01; 1 - EPRI $28.00; GPO Dep. File Number DE85003684.

This study is the second phase of a three-phase effort to evaluate existing geohydrochemical models and codes that apply to the study of leachate migration. The ultimate objective is to determine which models and codes can be adapted to supply an interim modeling capability and which models and codes require developmental effort to provide a long-term modeling capability for the electric utility industry. In this phase of the study, 20 codes (14 hydrology, 5 geochemistry, and 1 microbiology) have been exercised on hypothetical cases. The results of these simulations have led to the selection of a subset of codes for study in Phase 3. Separate analytics have been done for each of the phases.

7387 **(NP—5770110) Studies on the suitability of wild game as biological indicator for detection of environmental contamination in Lower Saxony.** Kleiminger, J. (Tieraerztliche Hochschule Hannover (Germany, F.R.)). 21 Jun 1983. 162p. (In German). NTIS (US Sales Only), PC A08/MF A01. File Number DE85770110.

The survey presents an evaluation of heavy metal contents in samples of hair, liver, kidney and muscle taken from roe deer, red deer, wild boar and hare in five different contaminated areas between 1980 and 82. The different metals show the same patterns of distribution in the corresponding tissues. The highest contents of Pb and As are found in hair, followed by kidneys, liver and muscle in declining sequence. Highest contents of Cd and Hg are found in kidneys, followed by liver, hair and muscle. Pb and As are distributed more evenly among the various tissues examined than Cd and Hg. Significant correlations for all metals can only be detected between the contents of liver and kidney. All species show an increased content of Pb and Cd in environments in which the soil revealed considerable charge of these metals. Remarkable spreading of values can be detected in the heavy metal contents in tissues: Differences among one species are mainly correlated to the origin of the animals and to the age of the individual animal. A substantial linkage between age and degree of contamination can only be detected with the element of cadmium. It can be recommended to utilize kidney tissue of roe deer as an indicator of environmental contamination in ecological systems of the wood and forest type, such as hare kidney in agricultural systems in the same manner.

7388 **(ORNL/TM—9092) Investigation of subsurface mercury at the Oak Ridge Y-12 Plant.** Rothschild, E.R.; Turner, R.R.; Stow, S.H.; Bogle, M.A.; Hyder, L.K.; Sealand, O.M.; Wyrick, H.J. (Oak Ridge National Lab., TN (USA)). Nov 1984. Contract AC05-84OR21400. 259p. NTIS, PC A12/MF A01; 1; GPO Dep. File Number DE85003816.

An investigation of the fate of spills and leaks of elemental mercury at the Oak Ridge Y-12 Plant has been carried out through a multiphased well installation and soil boring program. The overall program resulted in the installation of a 43-well monitoring network and the analysis of 430 soil/mud samples and 113 groundwater samples for mercury content. In addition, 59 analyses for uranium in groundwater were made, and 132 anion and cation analyses were run. The hydrogeology of the plant is dominated by the original Upper East Fork Poplar Creek drainage channel and the extensive solution cavity system that underlies the creek the Maynardville Limestone. Although the original hydrologic system at the plant has been altered due to construction and recontouring of the topography, the original drainage still plays an important role in the subsurface movement of water. Results of mercury analyses of soils and fill indicate that high concentrations (up to 1% by weight) of mercury occur in the shallow earth materials at several sites within the plant, but the estimated total quantity located (~ 7000 lb) represents only about 2% of the amount estimated to have been lost to the ground. Results of mercury analyses of groundwater indicate that mercury does not appear to be moving in significant quantities in an aqueous phase: the highest soluble concentrations found (~ 1 $\mu$g/L) were limited to three wells. The analyses of the groundwater samples for other chemical constituents revealed the presence of several contaminant plumes within the plant, including sulfates from a large coal pile, nitrates from liquid waste disposal operations, and chlorides from several sources, as well as general increases of electrical conductance and alkalinity. 26 references, 29 figures, 12 tables.

### 5103 Radioactive Materials Monitoring And Transport

*REFER ALSO TO CITATION(S) 5103006492, 6520, 6521, 6523, 6524, 6526, 6527, 6533, 7380, 7384*

7389 **(DPSPU—84-302) Environmental monitoring at the Savannah River Plant. Annual report, 1983.** Ashley, C.; Padezanin, P.C.; Zeigler, C.C. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant). Jun 1984. Contract AC09-76SR00001. 302p. NTIS, PC A14/MF A01; 1; GPO Dep. File Number DE85003616.

This annual report presents data for 1983 radioactivity and radioisotope concentrations in the air, water, plants, and animals of the Savannah River Plant. Additional monitoring was performed for chemical contaminants such as mercury and chlorocarbons. All concentrations were within applicable federal and state limits or not detectable with state-of-the-art monitoring equipment. (ACR)

7390 **(KFK—3715) Radioecological studies of the impacts of tritiun emissions as explained by the example of KfK.** Koenig, L.A.; Langguth, K.G.; Pagliosa, G.; Papadopoulos, D.; Radziwill, A.; Schulte, S.; Strack, S. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Hauptabteilung Sicherheit). May 1984. 102p. (In German). NTIS (US Sales Only), PC A06/MF A01. File Number DE84752291.

The amount of tritium discharged every year by the Karlsruhe Nuclear Research Centre via gaseous and liquid effluents is of the order of 200 TBq. This offers the opportunity of studying the radioecological behaviour of tritium in the environment under real conditions. Within the framework of a programme supported by

the Federal Ministry of the Interior (BMI) the following problems have been investigated: Effects of tritium released via the air pathway: deposition through precipitates (rain and snow), contamination of the soil and migration into the ground water, tritium in plants (tissue water and organic substance). Effects of tritium released via the liquid effluent pathway: burden on the main canal, tritium in water plants and fish (tissue water and organic substance), spread via the ground water, tritium in agricultural produces. First results are reported about the attempts for describing the model the radioecological behaviour observed. Sinde parameters (washout, rate of migration) which can be derived from the results available are distributed statistically, further measurements will be required. The investigations will be continued with the "improvement of description by models" as the central point of activity.

7391 **(LA-UR—84-3353) Using TLDs to monitor Los Alamos drillbacks at the Nevada test site.** Cucchiara, A.L.; Martin, A. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 7p. (CONF-850106—2). NTIS, PC A02. File Number DE85002389.

From 18. midyear topical symposium of the Health Physics Society; Colorado Springs, CO, USA (6 Jan 1985).

Los Alamos National Laboratory uses LiF TLDs to measure the quantity of radiation in the environment during drilling, sampling and hole cementing operations following underground nuclear testing. The procedures for preparing the TLDs, placing the TLDs in the field and their subsequent analysis and dose evaluation are presented. 5 references, 4 figures, 1 table.

7392 **(LA-UR—84-3390) Los Alamos racquetball contamination incident.** McAtee, J.L.; Stafford, R.G.; Dowdy, E.J.; Prestwood, R.J. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 5p. (CONF-850106—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85002379.

From 18. midyear topical symposium of the Health Physics Society; Colorado Springs, CO, USA (6 Jan 1985).

Several employees of the Los Alamos Plutonium Facility were found to have low levels of radioactivity on their hands and clothing when they arrived for work one morning. The initial concern was that the stringent contamination or material controls at the facility had failed, and that one or more of the employees had either accidentally or intentionally removed plutonium from the Laboratory premises. Fortunately, however, an investigation revealed that the source of the radioactivity was radon daughters electrostatically collected upon the surface of the racquetball and transferred by physical contact to the employees during an early morning racquetball game. This paper describes the events leading to the discovery of this phenomenon. 1 figure.

7393 (NIRS-RSD—59, pp 17-19) **Strontium-90 and cesium-137 in soil from June to September, 1981. Environmental and dietary materials.** Dec 1981. NTIS (US Sales Only), PC A03/MF A01. File Number TI85780155.

In Radioactivity survey data in Japan.

Soil was collected from the location in a spacious and flat area without past disturbance on the surface caused by dust storm, inflow and outflow due to precipitation and so on. Any place located under trees, in a stony area or inside river banks was avoided. Soil was taken from two layers of different depth, from surface to 5 cm, and from 5 to 20 cm. In course of air drying, lumps were crushed by hand, and plant roots and pebbles were removed. The soil was passed through a 2 mm sieve to remove small gravels. The sieved sample was heated in the presence of strontium and cesium carriers, together with sodium hydroxide, then heated with hydrochloric acid. Strontium and cesium were separated by radiochemical analysis, and the mounted precipitates were counted for activity using low background beta counters normally for 60 min. Net sample counting rates were corrected to obtain the content of strontium-90 and cesium-137 radioactivity per sample aliquot, and concentrations of these nuclides in the original sample were calculated. The maximum values obtained were 2000 pCi/kg of Sr-90 and 7100 pCi/kg of Cs-137 in Ota in July, 1981, and also 67 mCi/km$^2$ of Sr-90 and 180 mCi/km$^2$ of Cs-137 in Kashiwazaki in July, 1981.

7394 (NIRS-RSD—59) **Radioactivity survey data in Japan.** (National Inst. of Radiological Sciences, Chiba (Japan)). Dec 1981. 48p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85780155.

Items within the scope of EDB have been individually indexed and entered into the data base.

7395 **(ORNL—5785) TERRA: a computer code for simulating the transport of environmentally released radionuclides through agriculture.** Baes, C.F. III; Sharp, R.D.; Sjoreen, A.L.; Hermann, O.W. (Oak Ridge National Lab., TN (USA)). Nov 1984. Contract AC05-84OR21400. 90p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85003717.

TERRA is a computer code which calculates concentrations of radionuclides and ingrowing daughters in surface and root-zone soil, produce and feed, beef, and milk from a given deposition rate at any location in the conterminous United States. The code is fully integrated with seven other computer codes which together comprise a Computerized Radiological Risk Investigation System, CRRIS. Output from either the long range (> 100 km) atmospheric dispersion code RETADD-II or the short range (<80 km) atmospheric dispersion code ANEMOS, in the form of radionuclide air concentrations and ground deposition rates by downwind location, serves as input to TERRA. User-defined deposition rates and air concentrations may also be provided as input to TERRA through use of the PRIMUS computer code. The environmental concentrations of radionuclides predicted by TERRA serve as input to the ANDROS computer code which calculates population and individual intakes, exposures, doses, and risks. TERRA incorporates models to calculate uptake from soil and atmospheric deposition on four groups of produce for human consumption and four groups of livestock feeds. During the environmental transport simulation, intermediate calculations of interception fraction for leafy vegetables, produce directly exposed to atmospherically depositing material, pasture, hay, and silage are made based on location-specific estimates of standing crop biomass. Pasture productivity is estimated by a model which considers the number and types of cattle and sheep, pasture area, and annual production of other forages (hay and silage) at a given location. Calculations are made of the fraction of grain imported from outside the assessment area. TERRA output includes the above calculations and estimated radionuclide concentrations in plant produce, milk, and a beef composite by location.

7396 **(ORNL—5974) MLSOIL and DFSOIL - computer codes to estimate effective ground surface concentrations for dose computations.** Sjoreen, A.L.; Kocher, D.C.; Killough, G.G.; Miller, C.W. (Oak Ridge National Lab., TN (USA)). Nov 1984. Contract AC05-84OR21400. 132p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE85004393.

This report is a user's manual for MLSOIL (Multiple Layer SOIL model) and DFSOIL (Dose Factors for MLSOIL) and a documentation of the computational methods used in those two computer codes. MLSOIL calculates an effective ground surface concentration to be used in computations of external doses. This effective ground surface concentration is equal to (the computed dose in air from the concentration in the soil layers)/(the dose factor for computing dose in air from a plane). MLSOIL implements a five compartment linear-transfer model to calculate the concentrations of radionuclides in the soil following deposition on the ground surface from the atmosphere. The model considers leaching through the soil as well as radioactive decay and buildup. The element-specific transfer coefficients used in this model are a function of the k/sub d/ and environmental parameters. DFSOIL calculates the dose in air per unit concentration at 1 m above the ground from each of the five soil layers used in MLSOIL and the dose per unit concentration from an infinite plane source. MLSOIL and DFSOIL have been written to be part of the Computerized Radiological Risk Investigation System (CRRIS) which is designed for assessments of the health effects of airborne releases of radionuclides. 31 references, 3 figures, 4 tables.

7397 **(UCRL—91781) Analysis of the NAEG model of transuranic radionuclide transport and dose.** Kercher, J.R.; Anspaugh, L.R. (Lawrence Livermore National Lab., CA (USA)). Nov 1984. Contract W-7405-ENG-48. 58p. (CONF-830610—6). NTIS, PC A04/MF A01; GPO Dep. File Number DE85003451.

From Nevada Applied Ecology Group transuranics (and associated radionuclides) information conference; Las Vegas, NV, USA (28 Jun 1983).

We analyze the model for estimating the dose from $^{239}Pu$ developed for the Nevada Applied Ecology Group (NAEG) by using sensitivity analysis and uncertainty analysis. Sensitivity analysis results suggest that the air pathway is the critical pathway for the organs receiving the highest dose. Soil concentration and the factors controlling air concentration are the most important parameters. The only organ whose dose is sensitive to parameters in the ingestion pathway is the GI tract. The air pathway accounts for 100% of the dose to lung, upper respiratory tract, and thoracic lymph nodes; and 95% of its dose via ingestion. Leafy vegetable ingestion accounts for 70% of the dose from the ingestion pathway regardless of organ, peeled vegetables 20%; accidental soil ingestion 5%; ingestion of beef liver 4%; beef muscle 1%. Only a handful of model parameters control the dose for any one organ. The number of important parameters is usually less than 10. Uncertainty analysis indicates that choosing a uniform distribution for the input parameters produces a lognormal distribution of the dose. The ratio of the square root of the variance to the mean is three times greater for the doses than it is for the individual parameters. As found by the sensitivity analysis, the uncertainty analysis suggests that only a few parameters control the dose for each organ. All organs have similar distributions and variance to mean ratios except for the lymph modes. 16 references, 9 figures, 13 tables.

### 5105 Site Resource And Use Studies

*REFER ALSO TO CITATION(S) 5105006532*

7398 **(DOE/EV/05461—T2) Red-cockaded Woodpecker studies at the Savannah River Plant, South Carolina: 1976-1984. Final technical summary report.** Jackson, J.A. (Mississippi State Univ., Mississippi State (USA). Dept. of Biological Sciences). 1984. Contract AS05-77EV05461. 62p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85003678.

This report summarizes findings made during studies of the species ecology of the Red-cockaded Woodpecker (Picoides borealis), provides an evaluation of the effects of management practices used for the species at the Savannah River Plant, provides an assessment of the species current status on the site, and makes recommendations for the future of the species there. 42 references, 6 figures, 7 tables.

## 52 ENVIRONMENTAL SCIENCES, AQUATIC

### 5201 Basic Studies

*REFER ALSO TO CITATION(S) 5201007543*

### 5202 Chemicals Monitoring And Transport

*REFER ALSO TO CITATION(S) 5202006319, 6321, 6517, 7188, 7386, 7388, 7389, 7423*

7399 **(BNL—51757-Vol.1) Gas-liquid chemistry of natural waters. Volume 1.** Newman, L. (ed.). (Brookhaven National Lab., Upton, NY (USA)). Apr 1984. Contract AC02-76CH00016. 240p. (CONF-840489—Vol.1-Summs.). NTIS, PC A11/MF A01; 1; GPO Dep. File Number DE85002603.

From Gas-liquid chemistry of natural waters conference; Upton, NY, USA (1 Apr 1984).

Researchers from a variety of subdisciplines were convened to discuss mechanisms of oxidation in water. Scientists studying the chemistry of marine, freshwater on atmospheric systems participated. Both poster and oral presentations were used. Participants were asked to prepare extended abstracts with key references. These abstracts were complied and published in 2 volumes. Separate analytics have been done for each abstract.

7400 **(BNL—51757-Vol.2) Gas-liquid chemistry of natural waters. Volume 2.** Newman, L. (ed.). (Brookhaven National Lab., Upton, NY (USA)). Apr 1984. Contract AC02-76CH00016. 177p. (CONF-840489—Vol.2-Summs.). NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE85002457.

From Gas-liquid chemistry of natural waters conference; Upton, NY, USA (1 Apr 1984).

Researchers from a variety of subdisciplines were convened to discuss mechanisms of oxidation in water. Scientists studying the chemistry of marine, freshwater on atmospheric systems participated. Both poster and oral presentation were used. Participants were asked to prepare extended abstracts with key references. These abstracts were complied and published in 2 volumes. Separate analytics have been done for each abstract. (MF)

7401 **(DOE/EV/03801—T6) Chemistry of copper introduced into marine systems during energy production.** Carpenter, J.H. (Miami Univ., FL (USA). Rosenstiel School of Marine and Atmospheric Sciences). 1979. Contract AS05-76EV03801. 39p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85004330.

The nature of copper organic interactions in seawater was studied. The complexing capacity of local waters was measured. Procedures were developed to concentrate the chelating organics. A chromatographic procedure to look at metal chelation as a function of chromatographic support affinity was developed. 22 references, 4 figures. (ACR)

7402 **(DOE/EV/03801—T12) Ecology of subtropical, shallow water environments: chemistry of copper and chlorine introduced into marine systems during energy production. Final report.** Taylor, B.F. (Miami Univ., FL (USA). Rosenstiel School of Marine and Atmospheric Sciences). 31 Mar 1984. Contract AS05-76EV03801. 35p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85003703.

Research on the chemistry of copper and chlorine in marine systems is described. The nature of the interaction of copper with organic matter was investigated. Procedures were developed, using Rhodamine B, to quantify the principal chlorine-produced oxidants (CPO) in seawater. Procedures were developed for the rapid, automated and simultaneous determination of dissolved organic carbon and dissolved organo-phosphorus compounds in seawater. 54 references, 6 figures, 6 tables. (ACR)

7403 **(EPRI-CS—3738) ELECT groundwater transport research code. Final report.** (Battelle Pacific Northwest Labs., Richland, WA (USA)). Nov 1984. Contract AC06-76RL01830. 73p. NTIS, PC A04/MF A01 - EPRI $10.00; GPO Dep. File Number DE85003284.

The objective of this project was to produce a computer code for the solution of a wide range of contaminant transport problems. Based on Neuman's adaptive method, it combines the desirable features of both the method of characteristics and the finite element method. This should make the code applicable to a wide range of problems if the adaptive process can be appropriately controlled. In its present state the code should be considered a partially completed research code. Time and funding limitations prevented finding those parameter values and procedures necessary to adequately control the adaptive solution method. This document includes the analytical solution and program input data sets for the one- and two-dimensional transport problems being used to determine the needed controls. These two sample problems provide a means for continuing the study of the adaptive parameters for the code. 13 references, 4 figures.

7404 **(EPRI-CS—3739) Aqueous discharges from steam-electric power plants: trace metal sampling and analysis reference guide. Final report.** Maddalone, R.F.; Moyer, P.W.; Scott, J.W. (TRW, Inc., Redondo Beach, CA (USA)). Nov 1984. 251p. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $22.00. File Number TI85920133.

This report describes the results of a review of sampling and analysis methods for the thirteen priority pollutant metals (Ag, As, Be, Cd, Cr, Cu, Hg, Ni, Pb, Sg, Se, Tl, Zn). The literature review covered the period 1972 through 1982 and used on-line information services to search NTIS, Chemical Abstracts and DOE data bases. The titles and abstracts obtained from the keyword search were reviewed and the articles reflecting sampling and analysis methodology for matrices representative of the utility industry aqueous discharges were obtained and reviewed for this report. This reference guide contains both general discussions and reviews organized by element. General overview sections are provided on water sampling, Graphite Furnace Atomic Absorption Spectrometry (GFAAS) and multi-element analytical methods (Inductively Coupled Plasma and Differential Pulsed Anodic Stripping Voltammetry). The literature review for each of the priority pollutant metals compiles all available information on analytical capabilities, limitations, and applications. Included for each element are a listing of EPA-approved procedures from 44 FR 69559, December 3, 1979, estimated limits of detection and quantitation, the interferences cited, and references to sources describing the procedures. 62 references, 24 figures, 47 tables.

7405 **(EPRI-CS—3744) Aqueous discharges from steam-electric power plants: the precision and bias of methods for chemical analysis.** Maddalone, R.F.; Scott, J.W.; Powers, M.D. (TRW, Inc., Redondo Beach, CA (USA)). Nov 1984. 386p. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $29.50. File Number TI85920135.

The objective of this project is to provide the utility industry chemist with a compilation and assessment of precision and bias data on methods currently approved for NPDES monitoring of priority pollutant metals. To accomplish this objective, field and laboratory precision and bias data from governmental (EPA, USGS) and industrial groups (ASTM, APHA, UWAG) were collected, reduced and analyzed. As part of this effort, the 1980 DMR-QA data set was analyzed to determine the precision and bias of the EPA/State and Permittee laboratories data as a function of the method and procedure used. In addition to the DMR-QA effort, precision data from other governmental and industrial sources were used to compute regression equations of standard deviation (single operator and interlaboratory) versus test concentration. By extrapolating these regression lines to the zero x-intercept, the standard deviation of the blank can be estimated. Since both the limit of detection and quantitation are defined as a factor (generally 3X) of the standard deviation of the blank, regression analysis can be utilized to calculate limits of detection and quantitation. The calculated limits of detection and quantitation were then compared to published Water Quality Standards and the flow weighted non-cooling water discharge concentrations calculated earlier in EPRI Project RP 1851-1. Based on this analysis, both GFAAS and ICP could detect six of the thirteen priority pollutant metals. If Gaseous Hydride and Cold Vapor AAS are included under Flame AAS, then five of thirteen priority pollutant metals can be detected by Flame AAS. The importance of this analysis is becoming more apparent as discharge limits gradually are being set equal to state-of-the-art detection limits. This report will be useful for siting engineers and regulatory agencies involved in establishing pollution control requirements and effluent limitation guidelines, respectively.

7406 **(EPRI-EA—3221-Vol.4) Integrated lake-watershed acidification study. Volume 4. Summary of major results. Final report.** Goldstein, R.A.; Gherini, S.A. (eds.). (Tetra Tech, Inc., Lafayette, CA (USA)). Nov 1984. 206p. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $19.00. File Number TI85920118.

An integrated, interdisciplinary, intensive study of three forested watersheds was started in 1977 to quantify the relationship between the deposition of atmospheric acids and surface water acidity. A general mechanistic theory of lake-watershed acidification that takes into account the production and consumption of acidity by watershed processes, as well as atmospheric inputs of acidity, was developed. This theory is formulated as a mathematical simulation model. Model and data analyses establish the importance of using an integrated ecosystem perspective to assess the vulnerability of surface waters to acidification by acidic deposition. The acid-base status of surface waters is determined by the interaction of many factors: soil, hydrologic, vegetation, geologic, climatic, atmospheric. The absolute and relative contribution of any given factor can be highly variable, both geographically and temporally; hence, lake sensitivity to changes in the quality and quantity of atmospheric deposition is also highly variable. Separate analytics have been done for each of the 7 sections.

7407 **(ORNL/TM—9247) Documentation of a SAS program to calculate water quality indices.** Olson, R.J. (Oak Ridge National Lab., TN (USA)). Nov 1984. Contract AC05-84OR21400. 38p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85003542.

The Water Quality Index (WQI) program calculates use-impairment values at water quality monitoring stations to express the relative quality of surface water within a region. The method, as initially developed by EPA Region VIII staff, calculates an aggregated numeric index based on the exceedance of monitoring data for several parameters over established criteria values or water quality standards. The WQI program entails retrieving data from the EPA STORET system, processing the data with SAS programs, and mapping the WQI values. The report describes the processing steps, documents the SAS programs, and discusses concerns in acquiring input data and interpreting results. 1 figure.

7408 **(Y/DZ—136) In-situ denitrification of ponds.** Napier, J.M. (Oak Ridge Y-12 Plant, TN (USA)). 1 Nov 1984. Contract AC05-84OS21400. 7p. (CONF-841187—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE85002620.

From 5. DOE environmental protection information meeting; Albuquerque, NM, USA (6 Nov 1984).

An in-situ biological denitrification process successfully reduced nitrate ion concentrations in four 2.5 million gallon open-air holding ponds from nearly 40,000 mg/L to less than 50 mg/L. Concurrently, heavy metal concentrations were reduced to levels acceptable for discharge. 3 figures.

## 5203 Radioactive Materials Monitoring And Transport

*REFER ALSO TO CITATION(S) 5203006487, 6496, 6511, 6513, 6516, 6518, 6519, 6520, 6521, 6526, 6533, 7380, 7384, 7389, 7390, 7546*

7409 (FS—83-32-T, pp 555-565) **Fast and simple method for the determination of radium-226 in aqueous samples (drinking water, mineral water).** Berlich, J.; Gloebel, B. Nov 1983. (In German). Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland). (CONF-8306168—).

From 17. annual meeting of Fachverband fuer Strahlenschutz e.V.; Aachen, F.R. Germany (8 Jun 1983).

A method is described which allows direct determination of the radium-226 content in aqueous samples within a few hours. An exchanger for specific ions on a PAC basis is used in a special application. The evaluation is based on the measurement of the 4.78 MeV $\alpha$-particles of radium-226. The method is described, and its application to over 200 samples of drinking water and mineral water in the Federal Republic of Germany is reported. The average radium-226 concentration in drinking water from the Saarland is appr. 0.12 pCi of radium-226 per litre, and appr. 1.8 pCiof radium-226 per litre in mineral water from German mineral springs.

7410 (FS—83-32-T, pp 567-574) **Simple method for the determination of stable and radioactive lead-210 in aqueous samples.** Gloebel, B.; Keller, K.D. Nov 1983. (In German). Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland). (CONF-8306168—).

From 17. annual meeting of Fachverband fuer Strahlenschutz e.V.; Aachen, F.R. Germany (8 Jun 1983).

A measuring method is shown enabling the simultaneous detection of stable and radioactive lead by means of spontaneous deposition of dissolved lead on zinc metal. Upon enrichment, it is possible to establish the L $\alpha$ lines by x-ray fluorescence line scanning. The limit of detectability for stable lead is 8 $\mu$g per litre. Enriched bad-210 can be detected simulaneously using a spectrometer sensitive for the 48 keV range. The limit of detectability is 0.005 pCi of lead-210 per litre. This method enables low-cost fast analysis of aqueous samples. The report shows results of drinking water samples from wells in the Saarland. The average concentrations are 20 $\mu$g per litre for stable lead and 0.02 pCi per litre for lead-210.

7411 (NIRS-RSD—59, pp 22-23) **Strontium-90 and cesium-137 in sea sediments from July, 1981, to January, 1982. Environmental and dietary materials.** Dec 1981. NTIS (US Sales Only), PC A03/MF A01. File Number TI85780155.

In Radioactivity survey data in Japan.

Sediment was collected in the same area as that of sea water sampling, taking the following criteria into account: the depth of water exceeds 1 m at low tide, no significant sedimental movement is observed in the vicinity of concern, mud, silt and fine sand are preferable. A conventional sediment sampling device was used for collecting a top few cm of surface sediment. Approximately 4 kg of the sample in wet weight was spread on a large porcelain dish and dried in an electric oven to a constant weight. After removal of pebbles, shells and other foreign matters, the sediment sample was dried in a hot air oven, and ground finely with a mortar. The sample was passed through a 20 mesh sieve, and heated in the presence of strontium and cesium carriers with sodium hydroxide. Then it was heated with hydrochloric acid, and the radiochemical separation of strontium-90 and cesium-137 was performed. The mounted precipitates were counted for activity, and after the correction of net counting rates, concentrations of these nuclides were calculated. The maximum values obtained were 22 pCi/kg of Sr-90 and 220 pCi/kg of Sc-137 in Mutsu-bay in August, 1981.

7412 (NIRS-RSD—59, pp 14-15) **Strontium-90 and cesium-137 in service water from June to December, 1981. Environmental and dietary materials.** Dec 1981. NTIS (US Sales Only), PC A03/MF A01. File Number TI85780155.

In Radioactivity survey data in Japan.

Service water, 100 l each, was collected at an intake of a water treatment plant and at a tap after water was left running for five minutes. The carriers of strontium and cesium were added to water immediately after sampling, and the sample was vigorously stirred and filtered. Then it was passed through a cation exchange column at a rate of 80 ml/min. Strontium and cesium were deluted with hydrochloric acid from the cation exchange column, and separated. After the radiochemical separation, the mounted precipitates were counted for activity using low background beta counters normally for 60 min. Net sample counting rates were corrected for counter efficiency, recovery, self absorption and decay to obtain the content of strontium-90 and cesium-137 radioactivity per sample aliquot. From the results, concentrations of these nuclides in the original sample were calculated. The maximum values obtained were 0.29 pCi/l of Sr-90 in Kyoto in August, 1981, and 0.02 pCi/l of Cs-137 in Kyoto in August and in Inuyama in December, 1981, in case of source water. In case of tap water, they were 0.18 pCi/l of Sr-90 in Kobe in December, 1981, and 0.02 pCi/l of Cs-137 in Kyoto in August, 1981.

7413 **(RHO-RE-SR—84-24-P) Results of the separations area ground-water monitoring network for 1983.** Law, A.G.; Allen, R.M. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Jul 1984. Contract AC06-77RL01030. 124p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE85002869.

The objectives of the monitoring program are to (1) evaluate the quality of ground water for compliance with DOE orders, (2) assess the performance of disposal and storage sites in the Separations Area, (3) determine the impact of waste disposal operations on the ground water, and (4) provide data for hydrologic analyses and model application. The 1983 Spearation Area monitoring network included 112 wells. Water samples were collected monthly, quarterly or semiannually from the wells in the network. These samples were selectively analyzed for total alpha, total beta, tritium, strontium-90, cesium-137, cobalt-60, ruthenium-106, uranium and nitrate. Average radionuclide concentration in monitoring wells for 1983 were similar to those in 1982. Water levels were measured in 208 wells to produce the water table maps of the Separations Area (annually) and of the Hanford Site (semiannually). Radionuclide concentrations in the ground water were compared with Table II concentration guidelines of DOE Order 5480.1, Attachment XI-1, which are applicable at the Hanford Site boundary. Comparison of radionuclide concentration in a well with the Table II concentration at the site boundary is conservative since concentrations would be reduced by sorption, dispersion, dilution and decay by the time flow reached the site boundary. Tritium concentrations were greater than the Table II guidelines in a well monitoring the active 216-A-36B Crib disposal site. No other radionuclide concentrations from active sites exceeded Table II guidelines. The strontium-90 concentration was greater than Table II guidelines at two inactive disposal sites: the 216-B-5 Reverse Well and the 216-S-1 and S-2 Crib. The strontium-90 concentrations in the wells at these sites for 1983 were similar to the concentrations reported for 1982. The comtamination plumes for total beta, tritium and nitrate in 1983 were similar to those for 1982. 17 references, 19 figures, 17 tables.

## 5204 Thermal Effluents Monitoring And Transport

7414 **(DP-MS—84-99) Clean Water Act and biological studies at the Savannah River Plant.** Fleming, R.R. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1984. Contract AC09-76SR00001. 14p. (CONF-841187—13). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003563.

From 5. DOE environmental protection information meeting; Albuquerque, NM, USA (6 Nov 1984).

Federal facilities are required to comply with applicable water quality standards, effluent limitations, and permit requirements established by the EPA or agreement state pursuant to provision of the Federal Water Pollution Control Act, as amended in 1977 (P.L. 95-217). Production reactors and a large fossil-fueled powerplant at the Savannah River Plant (SRP) use either once-through water from the Savannah River or recirculating water from a 2700-acre reservoir to remove waste heat. Once-through cooling water is discharged directly to streams whose headwaters originate on the plant. The thermal load carried by these streams is largely dissipated by the time the streams reenter the river. However, effluent discharge temperatures to the streams and reservoir do not meet current criteria specified by the State of South Carolina for a National Pollutant Discharge Elimination System (NPDES) permit. Less stringent effluent limitations can be approved by the State if DOE can demonstrate that current or mitigated thermal discharges will ensure the protection and propagation of a balanced biological community within the receiving waters. Following information provided in the EPA 316(a) Technical Guidance Manual, biological studies were designed and implemented that will identify and determine the significance of impacts on waters receiving thermal effluents. Sampling is being conducted along the length of each thermal stream, in the cooling water reservoir, and along a 160-mile stretch of the Savannah River and in the mouths of 33 of its tributaries. Preliminary results of the 316(a) type studies and how they are being used to achieve compliance with State water quality regulations is discussed. 7 references, 3 figures, 4 tables.

7415 **(NP—5900352) Assessment of the thermal effects on striped bass larvae entrained in the heated discharge of the Indian Point Generating Facilities Units 2 and 3.** Carter, H.H.; Wilson, R.E.; Carroll, G.E. (State Univ. of New York, Stony Brook (USA). Marine Sciences Research Center). Jun 1979. 43p. Marine Sciences Research Center, State Univ. of New York, Stony Brook, NY 11794. File Number TI85900352.

Special report 24.

In this report the authors have modelled the excess temperature and velocity fields to evaluate thermally induced mortality levels of striped bass post yolk sac larvae entrained in the thermal plume of Indian Point-2 and -3. The model consists of separate near-field and far-field portions which were combined to form a complete-field model by vector addition of the velocity fields and

by superposition of the excess temperature fields based on a simple mixing concept. By calcuating and storing velocity and excess temperature fields appropriate to each of 20 different phases of the tide, our complete-field model follows, and calculates the thermal dose experienced by an assumed intial distribution of passive organisms where the receiving water velocities are time varying, such as occurs in a tidal estuary or coastal setting, as well as undirectional. Application of the model to the cooling water system of Indian Point Units 2 and 3 operating at 873 MWe each and an assumed line of striped bass post yolk sac larvae initially distributed laterally across the river surface upstream from the plant resulted in a list of thermal doses experienced by the larvae ordered with respect to maximum temperature. To evaluate the biological response of the organisms to these doses, thermal dose-excess temperature mortality curves for the 10% mortality level and acclimation temperatures of 15, 20, and 23°C were constructed for striped bass post yolk sac larvae. Comparison of the maximum calcuated thermal dose experienced by any of the plume entrained organisms with these curves indicates that less than 10% of the larvae entrained in the heated plume from Units 2 and 3 will be killed. The model further suggests that the zone of influence or withdrawal of the intakes is limited to 20 to 30 meters in the lateral direction.

### 5205 Site Resource And Use Studies

*REFER ALSO TO CITATION(S) 5205006319, 6488, 7414*

**7416 (DP-MS—84-89) Agency interaction at the Savannah River Plant under the Endangered Species Act.** Mackey, H.E. Jr. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1984. Contract AC09-76SR00001. 10p. (CONF-841187—12). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003565.

From 5. DOE environmental protection information meeting; Albuquerque, NM, USA (6 Nov 1984).

The 300 square mile Savannah River Plant (SRP) offers a variety of protected habitats for endangered species including the alligator (resident), red-cockaded woodpecker (resident), short-nose sturgeon (migratory), and wood stock (fish-forager). The most recent of these four species to be listed by the US Fish and Wildlife Service (US FWS) is the wood stock. It had been observed prior to 1983 as an infrequent forager in the SRP Savannah River swamp which adjoins SRP on the south and southwest. In anticipation of its listing as an endangered species, DOE-SR requested in the spring of 1983 that the Savannah River Ecology Laboratory, University of Georgia, conduct field surveys and studies of the nearest colony of wood storks to SRP (the Birdsville colony in north-central Georgia). The objective of these studies was to determine potential effects of the flooding of the Steel Creek swamp area with cooling water from L-Reactor. L-Reactor, which is proposed for restart, has not been operated since 1968. The survey found that wood storks forage in the Steel Creek delta swamp area of the Savannah River at SRP. Based on the numbers of storks at various foraging locations, sites at SRP ranked higher than non-SRP sites during the pre-fledging phase of the colony. Cold flow testing of L-Reactor also demonstrated that foraging sites in the Steel Creek delta would be unavailable during L-Reactor operation because of increased water levels. Consultation meetings between DOE-SR and US FWS in April 1984, resulted in an agreement between the two agencies to develop alternative foraging habitat for the wood stork to replace potential losses in the Steel Creek delta area. A suitable habitat was located on the National Audubon Society's Silver Bluff Plantation Sanctuary just west of SRP. This location will be developed by the US Soil Conservation Service through an interagency agreement with DOE-SR. 6 references, 4 figures.

**7417 (DP-MS—84-91) Remote sensing of wetlands at the Savannah River Plant.** Christensen, E.J.; Jensen, J.R.; Sharitz, R.R. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.; South Carolina Univ., Columbia (USA); Savannah River Ecology Lab., Aiken, SC (USA)). 1984. Contract AC09-76SR00001. 15p. (CONF-841187—11). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003560.

From 5. DOE environmental protection information meeting; Albuquerque, NM, USA (6 Nov 1984).

The Savannah River Plant (SRP) occupies about 300 sq mi along a 10-mile stretch of the Savannah River. Large areas of wetlands cover the site, especially along tributary stream floodplains and the Savannah River. Some of these areas have been altered by cooling water discharges from nuclear production reactors onsite. To assess the effects of current and future plant operations on SRP and regional wetlands, an accurate quantitative survey was needed. Several studies were initiated to provide wetland acreage and distribution information: (1) Regional wetland inventories were provided from an analysis of LANDSAT multispectral scanner (MSS) satellite data. Wetlands were mapped throughout the entire Savannah River watershed and in the Savannah River floodplain. (2) SRP wetlands were identified using a combination of LANDSAT MSS and Thematic Mapper satellite data and aerial photography. (3) Wetlands in the SRP Savannah River swamp and thermally affected areas were mapped using high resolution MSS data collected from a low-flying aircraft. Vegetation communities in areas receiving cooling water discharges were then compared to surface temperatures measured from the airborne scanner at the same time to evaluate plant temperature tolerance. Historic changes to SRP wetlands from cooling water discharges were tabulated using aerial photography. 5 references, 3 figures, 5 tables.

## 53 ENVIRONMENTAL-SOCIAL ASPECTS OF ENERGY TECHNOLOGIES

**7418 (DOE/EI/02295—T5) State responses to the adverse impacts of energy development in Texas.** Sanderson, D.R. (Massachusetts Inst. of Tech., Cambridge (USA). Lab. of Architecture and Planning). Jun 1977. Contract AM01-76EI02295. 86p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85002888.

Although energy development seems generally desirable to Texans, it can create problems for certain boomtown communities. These municipalities are often incapable of maintaining public services at a level needed by their rapidly expanding population. The two types of energy development in Texas - oil drilling (Southwest Texas) and lignite mining and consumption (East Texas) - present similar but not identical problems for local officials. Neither elected state officials nor agency staff members tend to be convinced that local governments have serious difficulties providing necessary public services to boomtown immigrants. This view of the state's role parallels the view of most local officials. They usually maintain that local governments should manage their own problems. While state agencies in Texas have not addressed the impacts of energy development per se, with slight modifications several existing programs could provide assistance.

### 5301 Social And Economic Studies

*REFER ALSO TO CITATION(S) 5301006505*

**7419 (DOE/AD/11256—T1) Socio-economic impact of rising energy cost on minorities.** Rahimian, N.; Chang, P.; Yousif, S. (Alabama A and M Univ., Normal (USA). Dept. of Economics). 30 Sep 1982. Contract FG01-81AD11256. 109p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE85003822.

This study investigates minority group consumer behavior in relation to the cost of energy in the southeast. The research program consists of 5 tasks: literature survey; survey objectives and models; average expenditure and percent of annual income spent on energy and regression analysis of the electricity and the natural gas demand functions; simulation analysis; and a review of existing energy policies and some policy recommendations. In addition, the effects of energy conserving actions in houses are also evaluated in terms of percent of income spent on electricity and natural gas. 30 tables.

**7420 (INIS-mf—9085) Nuclear power plants and housebuilding.** (Ministerie van Volkshuisvesting en Ruimtelijke Ordening, Delft (Netherlands)). Apr 1982. 42p. (In Dutch). NTIS (US Sales Only), PC A03/MF A01. File Number DE85780150.

In this report, it is studied where and under what conditions houses can be built in the neighbourhood of nuclear power plants. Building norms and location distances are investigated. First, the Dutch and foreign norms with respect to population densities are listed. Only industrial, densely populated neighbour countries are considered. Next, it is calculated what consequences for housing a nuclear station may have within a radius of 20 km. Using these calculations it is studied whether the existing Dutch requirements are satisfied. Because it is expected that the norms are likely to be tightened up under the pressure of the nuclear controversy, the existing Dutch situation is also compared with the tighter foreign norms. Finally, the results of the study are summarized and some conclusions are drawn.

### 5302 Assessment Of Energy Technologies

*REFER ALSO TO CITATION(S) 5302006924, 7529*

7421 **(OCS/MMS—84-0007) Draft environmental impact statement: proposed 1985 Outer Continental Shelf oil and gas lease sale No. 90 offshore the south Atlantic states.** (Minerals Management Service, Vienna, VA (USA). Atlantic OCS Region). Apr 1984. 640p. NTIS, PC A99/MF A01. File Number DE85900316.

The proposed action is the offering of 7245 blocks (40.8 million acres; 16.5 million hectares) located from 12 to 210 statute miles offshore North Carolina, South Carolina, Georgia, and Florida for leasing in accordance with the Outer Continental Shelf Lands Act, as amended. The average water depths of the blocks range from 30 to 3900 m (98 to 12,796 feet). Sale No. 90 will be held in March 1985. Alternatives considered include a delay of the salt, canceling the sale (no action), and four deferral options. The deferral options include one to protect coastal and nearshore resources, one relating to blocks in the clearance zone for the NASA Kennedy Space Center and Eastern Space and Missile Center, one to protect the calico scallop and royal red shrimp fishing grounds, and one to protect the nominated Oculina National Marine Sanctuary. All blocks studied pose some degree of risk to the environment. Mitigating measures, which may reduce the risk, have been identified. 379 references, 22 figures, 46 tables.

### 5303 Environmental Impact Statements

7422 **(DOE/EIS—0066/F) Role of the Bonneville Power Administration in the Pacific Northwest Power Supply System including its participation in a hydro-thermal power program. Final environmental impact statement.** (USDOE Bonneville Power Administration, Portland, OR). Dec 1980. 845p. NTIS, PC A99/MF A01; 1; GPO Dep. File Number DE85003561.

This statement evaluates the environmental impacts associated with the operation and development of the regional power system under various levels of regional cooperation and coordination. This analysis examines the impacts of these varying institutional arrangements upon the operation of the existing/committed regional system, as well as their generic effect upon the future development of a coordinated regional power planning process. Also a worst-case analysis of future power resource development is presented. Included as part of this resource analysis is a series of scenarios which evaluate the impacts of nonthermal and thermal resource development. Those alternatives or institutional arrangements which advocate a formalized and comprehensive regional decisionmaking process are felt to be environmentally preferable in that they assure the consideration of nonpower interests and maximize the efficient use of the existing system. 142 references, 10 figures, 54 tables.

7423 **(NP—4901545) Gulf of Alaska/Cook Inlet Lease Sale 88. Final environmental impact statement. Volume 2. Appendices.** (Minerals Management Service, Anchorage, AK (USA). Alaska Outer Continental Shelf Region). Jul 1984. 190p. I. File Number TI84901545.

The statement discusses a proposal for oil-and-gas leasing in the Gulf of Alaska/Cook Inlet, alternatives to the proposal, major issues determined through the scoping process and through staff analyses, and potential mitigating measures. This volume contains appendices to the statement. (ACR)

## 55 BIOMEDICAL SCIENCES, BASIC STUDIES

7424 **Effect of collector size on forest litter-fall collection and analysis.** McShane, M.C.; Carlile, D.W.; Hinds, W.T. (Pacific Northwest Lab., Richland, WA). *Canadian Journal of Forest Research;* **13**: No. 6, 1037-1042(1983). Contract AC06-76RL01830.

Litter fall is commonly collected for a variety of ecological studies. This study was designed to test the effect of collector size on the precision of forest litter-fall estimates and on the time involved in laboratory sample sorting. Collectors varied in size from 0.010 to 0.933 $m^2$ and were physically nested, the smaller units with in larger units. Ten of these collector combinations were randomly placed on a 1-ha plot in a Douglas-fir/western hemlock (Pseudotsuga menziesii (Mirb.) Franco/Tsuga heterophylla (Raf.) Sarg.) stand in H.J. Andrews Experimental Forest. Collections were made monthly and records were kept of the time required to sort the litter into needles, epiphytes, and miscellaneous categories. Based on a definition of precision as +/- 10% of the mean, 90% of the time, results indicate (i) that the cost of obtaining precise estimates of needle fall decreases with decreasing collector size to 0.010 $m^2$, (ii) that collectors of any size can be used to obtain estimates of total litter fall if the number of collectors required to obtain precise results is determined, and (iii) that precise estimates of epiphyte biomass require large numbers of samplers and are not cost effective.

### 5501 Behavioral Biology

7425 **(DOE/EV/05461—T1) Hoarding patterns in the southern flying squirrel (Glaucomys volans).** Clemmer, S.M. (Mississippi State Univ., Mississippi State (USA). Dept. of Biological Sciences). May 1984. Contract AS05-77EV05461. 48p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85003802.

Southern flying squirrels, Glaucomys volans, were individually offered two size classes of pecans in a 1:1 ratio to establish preference. All but one squirrel preferred small pecans. As relative abundance of preferred food diminished to 0.10, squirrels switched preference. Absolute abundance of either food did not affect caching levels. A difficulty-of-retrieval experiment did not result in switching of preference. No effect of sex on hoarding was exhibited. There was an inverse correlation between individual storing effort and caching levels of the same squirrels tested as pairs, with individual non-storers showing increases in numbers of pecans stored. Animals that were active storers as individuals showed decreases when paired. Total number stored did not decrease significantly when squirrels were offered previously marked pecans. When offered own-marked and other-marked pecans, squirrels did not discriminate. 43 references, 3 figures, 6 tables.

### 5502 Biochemistry

*REFER ALSO TO CITATION(S) 5502006921, 7204, 7442, 7443*

7426 **(DOE/ER/04310—T2) Primary light harvesting system: the relationship of phycobilisomes to photosystem I and II. Progress report, September 1983-March 1984.** Gantt, E. (Smithsonian Institution, Rockville, MD (USA). Smithsonian Environmental Research Center). 1984. Contract AS05-76ER04310. 5p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85003075.

It has long been known that energy absorbed by phycobiliproteins is transferred to photosystem II and is then distributed to I. Consequently, it has been predicted that phycobilisomes would be in close association with photosystem II. Our laboratory has succeeded in isolating phycobilisomes which have photosystem II activity, as measured by oxygen evolution, and reduction of dichlorophenol indophenol. In a special medium (0.5 M phosphate buffer, 0.5 M sucrose, 0.3 M citrate, and 10 mM magnesium chloride) the

phycobilisomes remain intact, and the PS II activity is preserved. These preparations are deficient in the PS I reaction center pigment P700, as well as in the PS I polypeptide CP 1. Preparations of this system are being further characterized to determine the P680 content, to ascertain the DCMU-binding protein, cytochromes, and other polypeptides which are specific for PS II, and also for PS I. In addition, the sidedness of thylakoid membranes of red algae and cyanobacteria are also being explored by immunocytochemistry (EM) and fractionation on acrylamide gels. Attachment of the phycobilisomes, and the location of the terminal emitter of phycobilisomes, are an integral part of these studies. Results from these studies will aid in our understanding of the energy transfer in the photosynthetic apparatus of these groups of organisms which appear to have a considerable convergence from green plants.

7427 **[$^{125}$I] 3-Quinuclidinyl 4-iodobenzilate: a high affinity, high specific activity radioligand for the $M_1$ and $M_2$-acetylcholine receptors.** Gibson, R.E.; Rzeszotarski, W.J.; Jagoda, E.M.; Francis, B.E.; Reba, R.C.; Eckelman, W.C. (George Washington Univ. Medical Center, Washington, DC). *Life Sciences;* **34**: No. 23, 2287-2296(4 Jun 1984).

A radioiodinated ligand has been prepared which binds with high affinity to the muscarinic acetylcholine receptor (m-AChR). A derivative of 3-quinuclidinyl benzilate, [$^{125}$I] labeled (R) 1-azabicyclo(2.2.2)oct-3-yl (R,S)-α-hydroxy-α-(4-[$^{125}$I]iodophenyl)phenyl acetate (4-IQNB) exhibits an affinity for the m-AChR from corpus striatum higher than that of (R) [$^3$H] QNB. Additionally, [$^{125}$I] 4-IQNB exhibits receptor selectivity for the $M_1$ receptor since the affinity for the receptor from dog and rat heart is lower than that using dog or rat corpus striatum.

7428 **Endotoxin suppresses expression of apoprotein E by mouse macrophages in vivo and in culture: a biochemical and genetic study.** Werb, Z.; Chin, J.R. (Univ. of California, San Francisco). *Journal of Biological Chemistry;* **258**: No. 17, 10642-10648(10 Sep 1983). Contract AC03-76SF01012.

The synthesis and secretion of apo-E, a component of plasma lipoproteins, are suppressed in mouse macrophages exposed to bacterial lipopolysaccharide endotoxin (LPS) in culture or in vivo. Control mouse macrophages contained intracellular immunofluorescent apo-E, and apo-E represented about 10% of secreted protein. After intraperitoneal injection of LPS, freshly lavaged macrophages neither contained intracellular apo-E nor secreted apo-E. The suppressive effects of LPS and apo-E synthesis in culture were selective, and secretion of many other major macrophage proteins was not affected. When then LPS-elicited macrosphages were cultured for 24-72 h in the absence of LPS, synthesis of apo-E was initiated. Treatment of bone marrow-derived or peritoneal macrophages in culture with less than 1 ng of LPS/ml inhibited apo-E synthesis and secretion by 18 h of treatment. Although LPS stimulates prostaglandin $E_2$ synthesis, prostaglandin $E_2$ itself did not suppress apo-E synthesis. Macrophages from C3H/HeJ (Lps/sup d// Lps/sup d/) mice, which are resistant to LPS, were neither primed for $H_2O_2$ production nor suppressed for apo-E synthesis in response to LPS in vivo (30 μg/mouse) or in culture (1μ/ml), whereas macrophages from the co-isogenic C3H/HeN (Lps/sup n//Lps/sup n/ ) strain were induced for $H_2O_2$ secretion and had suppressed synthesis of apo-E. Because apo-E serves as a recognition determinant for the receptor-mediated clearance of lipoproteins, the decreased synthesis of apo-E after LPS treatment may in part explain the hyperlipoproteinemia associated with endotoxins in vivo.

7429 **2-Bromoacetylaminopentitol 1,5-bisphosphate as an affinity label for ribulose bisphosphate carboxylase/oxygenase from Rhodospirillum rubrum.** Fraij, B.; Hartman, F.C. (Oak Ridge National Lab., TN). *Journal of Biological Chemistry;* **257**: No. 7, 3501-3505(10 Apr 1982). Contract W-7405-ENG-26.

2-Bromoacetylaminopentitol 1,5-bisphosphate (BrAcNH-pentitol-$P_2$)(an epimeric mixture of 2-bromoacetylamino-2-deoxy-D-ribitol bisphosphate and 2-bromo-acetylamino-2-deoxy-D-arabinitol 1,5-bisphosphate) has been synthesized from D-ribulose 1,5-bisphosphate by reductive amination with sodium cyanoborohydride followed by bromoacetylation of the resultant amine with bromoacetyl bromide. Under conditions that favor full activation of the enzyme, ribulose bisphosphate carboxylase/oxygenase from Rhodospirillum rubrum is completely inactivated by BrAcNH-pentitol-$P_2$ in a pseudo-first order process. A rate saturation is observed with a minimal inactivation half-life of 38 min and K/sub inact/ for reagent of 0.38 mM. The competitive inhibitor 2-carboxyribitol 1,5-bisphosphate reduces the rate of inactivation, and kinetic analyses are consistent with the protection reflecting true competition of inhibitor and reagent for the same site. As shown with isotopically labeled reagent complete inactivation is associated with covalent incorporation of 1.1 mol of reagent/mol of subunit. Based on reversibility of inactivation by thiolysis and based on analysis of labeled products in acid hydrolysates of the modified enzyme, a methionyl sulfonium salt is the reaction product. In the absence of $CO_2$ and $Mg^{2+}$ (ligands required for activation), the enzyme is resistant to BrAcNH-pentitol-$P_2$, which suggests that the site-specific modification of a methionyl residue requires a fully functional catalytic center.

7430 **Purification and biosynthesis of quench spot, a drosopterin precursor in Drosophila melanogaster.** Dorsett, D.; Jacobson, K.B. (Oak Ridge National Lab., TN). *Biochemistry;* **21**: No. 6, 1238-1243(1982). Contract W-7405-ENG-26.

Pteridine biosynthesis has been examined in extracts of the heads of Drosophila melanogaster by measuring the conversion of dihydroneopterin triphosphate to sepiapterin and the "drosopterins" (six eye pigments that are dipterin derivatives). These two products share a common first step in the production of an intermediate that is a branch point from which both products are formed. This first step can be catalyzed by sepiapterin synthase or by an enzyme found in particles that sediment at 600 g. A substance named "quench spot" was found earlier to be at low levels in the purple mutants that were defective in drosopterin synthesis and to be restored to normal when a suppressor mutant, su(s)$^2$, restored drosopterins in purple to normal levels. The sepia mutant is also deficient in the levels of both quench spot and drosopterins. In this report the authors propose that quench spot is a precursor of drosopterins, but not sepiapterin, and that it is formed from the sepiapterin synthase intermediate mentioned above. An additional precursor that is formed independently of the sepiapterin synthase pathway is also proposed that would react with quench spot to form drosopterins.

## 5503 Cytology

7431 **Onset of apoprotein E secretion during differentiation of mouse bone marrow-derived mononuclear phagocytes.** Werb, Z.; Chin, J.R. (Univ. of California, San Francisco). *Journal of Cell Biology;* **97**: 1113-1118(Oct 1983). Contract AC03-76SF01012.

A number of macrophage functions were sequentially expressed when the bone marrow precursors of mononuclear phagocytes differentiated in culture in the presence of a specific growth factor, colony-stimulating factor-1. The authors defined the expression of apoprotein E (ApoE), a major secreted protein of resident peritoneal macrophages, during maturation of adherent bone marrow-derived mononuclear phagocytes into macrophages. By 5 d the bone marrow macrophages were active secretory cells, but few cells contained intracellular immunoreactive ApoE, and little, if any, ApoE was secreted. ApoE secretion was initiated at 9 d, and this correlated with an increase in the percentage of macrophages containing intracellular ApoE. The onset of ApoE secretion was selective, and little change occurred in the other major secreted proteins detected by [$^{35}$S]methionine incorporation. In parallel, the high rate of plasminogen activator secretion, which peaked at 7 d, decreased markedly. ApoE secretion was not associated with altered expression of the macrophage surface antigen, Ia, or with secretion of fibronectin. Virtually all cells in independent colonies of bone marrow-derived macrophages eventually expressed ApoE. The proliferating monocyte/macrophage-like cell lines P388D1, J774.2, WHEI-3, RAW 264.1, and MGI.D$^+$ secreted little or no ApoE. These data establish that ApoE secretion is developmentally regulated.

7432 **Cytometry of deoxyribonuclei acid content and morphology of mammalian sperm.** Gledhill, B.L. (Lawrence Livermore National Lab., CA). *Journal of Dairy Science;* **66**: No. 12, 2623-2634(1983). Contract W-7405-ENG-48.

Because spermatogenesis is exquisitely sensitive to external influences, sperm can serve as a biological dosimeter. Advances in interpreting induced sperm abnormalities require a better understanding of sperm characteristics. This report reviews the application of several methods for automated, quantitative detection of shape changes, methods that are faster and more sensitive than conventional subjective technqiues. Variability of sperm deoxyribonucleic acid content as a bioassay of genetic damage is explored, and limitations of the bioassay are discussed. New flow cytometric techniques that could lead to sexing mammalian sperm are examined.

7433 **Annulate lamellae in hemipteran preblastoderm cytoplasm and nuclei.** Gassner, G.; Sears, S. (Dept. of Agriculture, Fargo, ND). *Wilhelm Roux' Archives of Developmental Biology;* **181**: 183-188(1977).

Annulate lamellae (AL) were found in preblastoderm cytoplasm and nuclei of the giant milkweed bug, Oncopeltus fasciatus. To the best of the authors' knowledge, this is the first report of such an occurrence among the insects. Cytoplasmic AL were scattered about the nucleus during early prophase and then accumulated during late prophase to form two dome-shaped arrays lying opposite each other with the nucleus interposed. Also, intranuclear annulate lamellae were fou nd as single strands or vesicles within the nucleus during prophase.

## 5504 Genetics

*REFER ALSO TO CITATION(S) 5504006921, 7495*

7434 **Physical mapping and complete nucleotide sequence of the denV gene of bacteriophage T4.** Radany, E.H.; Naumovski, L.; Love, J.D.; Gutekunst, K.A.; Hall, D.H.; Friedberg, E.C. (Stanford Univ. Medical Center, CA). *Journal of Virology;* **52**: No. 3, 846-856(Dec 1984).

Phage T4 deletion mutants that are folate analog resistant (far) and contain deletion in the region of the T4 genome near denV have been isolated previously. We showed that one of these mutants (T4farP12) expressed normal denV gene activity, whereas another mutant (T4farP13) was defective in the denV gene. The rII-distal (right) physical endpoints of these deletions defined the limits of the interval in which the rII-proximal (left) endpoint of the denV gene should be located. The deletion endpoints were identified by restriction and southern hybridization analyses of phage derivatives containing deoxycytidine instead of hydroxymethyldeoxycytidine in their DNAs. The results of these analyses localized the rII-proximal (left) end of the denV gene to a region between 62.4 and 64.3 kilobases on the T4 physical map. denV$^+$ phage resulted from marker rescue with two of five denV$^-$ alleles tested, using plasmids containing a 1.8-kilobase fragment from this region or a 179-base-pair terminal fragment derived from it. Sequencing of the 179-base-pair fragment from wild-type DNA showed a 130-base-pair open reading frame with its termination codon at the rII-proximal end. Confirmation that this open reading frame is part of the denV coding sequence was obtained by identifying a TAG amber codon in the homologous DNA derived from a denV amber mutant strain. This mutant strain rescued the denV$^+$ allele from plasmids containing the wild-type sequence. An adjacent overlapping restriction fragment was also cloned, permitting determination of the remaining denV gene sequence. Based on these results, the 3′ end of the coding region of the denV locus was mapped to kilobase position 64.07 on the T4 physical map, and the 5′ end was mapped to position 64.48.

7435 **Screwworm karyotyping and species diversity.** Richardson, R.H.; Ellison, J.R. (Univ. of Texas, Austin). *American Naturalist;* **124**: No. 5, 765-767(Nov 1984).

The authors have reported morphological diversity in the chromosomes of screwworm populations, many of which were sympatric. The morphological diversity of the metaphase chromosomes allows cytogeneticists to identify the various heterozygotes and homozygotes. From such data it is possible to differentiate a mixture of populations through a Wahlund effect, and under certain conditions document the presence of distinct species. This discussion concerns the questioning by another researcher of the authors' evidence for the existence of gamodemes and cryptic species in the screwworm fly. The issues in question are explained.

7436 **Review of the international symposium on sister chromatid exchanges: twenty-five years of experimental research.** Tice, R.R.; Lambert, B.; Morimoto, K.; Hollaender, A. (Brookhaven National Lab., Upton, NY). *Environmental Mutagenesis;* **6**: No. 5, 737-752(1984).

The purpose of this symposium, held on December 4-8, 1983, at Brookhaven National Laboratory at Upton, NY and cosponsored by the Biology and Medical Departments, was to bring internationally recognized leaders in the fields of genetics, cytogenetics, carcinogenesis, mutagenesis, radiation biology, toxicology, and environmental health together into an open forum to present and discuss (i) current knowledge of the induction and formation of SCEs and their relationship to other biological endpoints; (ii) the optimal strategies for the utilization of SCEs in genetic toxicology testing schemes involving in vitro and in vivo exposure situations; (iii) the most valid statistical methods for analyzing SCE data; and (iv) the presence of the SCE-inducing DNA damage in human lymphocytes.

7437 **Role of AP endonuclease in DNA breakage and cell inactivation of Escherichia coli subjected to mild heat (52°C).** Williams-Hill, D.M.; Grecz, N. (Argonne National Lab., IL). *Mutation Research;* **107**: 13-21(1983). Contract W-31-109-ENG-38.

The molecular mechanism of DNA injury by mild heat was investigated using matched isogenic mutants of E. coli. On heating at 52°C for 1 h, the number of DNA single-strand breaks (SSBs) detected by the alkaline sucrose gradient sedimentation technique was consistently smaller in mutants NH5016 and BW2001, both deficient in the AP (apurinic/apyrimidinic) endonuclease of exonuclease III, as compared with their wild-type parent AB1157. The greater number of SSBs in the wild type was accompanied by more extensive cell death as compared with the AP-deficient mutants. Heating of endonuclease-free DNA systems, viz., T4 phage and T4 DNA, at 52°C for up to 4 h did not result in any detectable SSB. Apparently, cellular injury by mild heat is self-inflicted through an AP-endonuclease-mediated process and hence depends on the cell's genetic complement of AP endonuclease. Mild heat is believed to activate the nucleolytic attack, and the resultant DNA-strand breaks, if not repaired, will eventually lead to cell death.

7438 **Isolation and characterization of yeast DNA repair genes. II. Isolation of plasmids that complement the mutations rad50-1, rad51-1, rad54-3, and rad55-3.** Calderon, I.L.; Contopoulou, C.R.; Mortimer, R.K. (Univ. of California, Berkeley). *Current Genetics;* **7**: 93-100(1983). Contract AC03-76SF00098.

Plasmids that complement the yeast mutations rad50-1, rad51-1, rad54-3, and rad55-3 were obtained by transforming strains that carried a leu2 marker and the particular rad mutation, with YEp 13 plasmids containing near random yeast DNA inserts. Integration of these plasmids or of fragments of these plasmids was accomplished. Genetic studies using the integrants established the presence of the genes RAD50, RAD54 and RAD55 in the respective plasmids. However, a BamHI subclone of the rad50-1 complementing plasmid failed to integrate at the RAD50 locus, indicating that no homology exists between this fragment and the RAD50 gene. A BamHI fragment for the RAD54 plasmid was shown to be internal to the RAD54 gene: its integration within a wild type copy of RAD54 causes the cell to become Rad$^-$; its excision is X-ray inducible and restores the Rad$^-$ phenotype. Since cells bearing a disrupted copy of RAD54 are able to survive, the author concludes that this is not essential.

**7439 Mutation frequencies in male mice and the estimation of genetic hazards of radiation in men: (specific-locus mutations/dose-rate effect/doubling dose/risk estimation).** Russell, W.L.; Kelly, E.M. (Oak Ridge National Lab., TN). *Proceedings of the National Academy of Sciences of the United States of America;* **79**: 542-544(Jan 1982). Contract W-7405-ENG-26.

Estimation of the genetic hazards of ionizing radiation in men is based largely on the frequency of transmitted specific-locus mutations induced in mouse spermatogonial stem cells at low radiation dose rates. The publication of new data on this subject has permitted a fresh review of all the information available. The data continue to show no discrepancy from the interpretation that, although mutation frequency decreases markedly as dose rate is decreased from 90 to 0.8 R/min (1 R = 2.6 X $10^{-4}$ coulombs/kg) there seems to be no further change below 0.8 R/min over the range from that dose rate to 0.0007 R/min. Simple mathematical models are used to compute: (a) a maximum likelihood estimate of the induced mutation frequency at the low dose rates, and (b) a maximum likelihood estimate of the ratio of this to the mutation frequency at high dose rates in the range of 72 to 90 R/min. In the application of these results to the estimation of genetic hazards of radiation in man, the former value can be used to calculate a doubling dose - i.e., the dose of radiation that induces a mutation frequency equal to the spontaneous frequency. The doubling dose based on the low-dose-rate data compiled here is 110 R. The ratio of the mutation frequency at low dose rate to that at high dose rate is useful when it becomes necessary to extrapolate from experimental determinations, or from human data, at high dose rates to the expected risk at low dose rates. The ratio derived from the present analysis is 0.33.

**7440 Effect of seven antibiotics on the growth and reproduction of Heliothis subflexa X H. virescens interspecific hydrids and backcross males.** LaChance, L.E.; Karpenko, C.P. (Dept. of Agriculture, Fargo, ND). *Annals of the Entomological Society of America;* **74**: No. 5, 493-497(Sep 1981).

To test the hypothesis that a maternally transmitted cytoplasmic microorganism is involved in male hybrid sterility found in H. subflexa (Guenee) X H. virescens (F.) hybrid and backcross progeny, we reared H. subflexa, hybrids and backcross progeny on larval diets containing high concentrations of tetracycline, penicillin G, chloramphenicol, ampicillin, gentamicin, rifampin, and 5-iodo-2'-deoxyuridine. The insects tolerated relatively high concentrations (from 120 mg/liter to 6 g/liter) of antibiotics in the larval diet and showed virtually no changes in larval or pupal developmental time, adult lifespan, or fertility. Hybrid and backcross males reared on such adulterated diets were as sterile as those reared on conventional diets.

**7441 Interstrain and interspecific crosses between Pectinophora gossypiella and P. scutigera.** LaChance, L.E.; Ruud, R.L. (Dept. of Agriculture, Fargo, ND). *Journal of Economic Entomology;* **72**: No. 4, 618-620(Aug 1979).

Crosses between a strain of Pectinophora gossypiella (Saunders) from Australia and from the US were fully fertile. Reciprocal crosses between both these strains and P. Scutigera (Holdaway) were characterized by reduced mating and eupyrene sperm transfer and low fecundity and fertility. $F_1$ progeny obtained by crossing P. scutigera females with P. gossypiella males (US strain) were sterile when backcrossed to P. gossypiella (US strain) but fully fertile when backcrossed to P. scutigera. Also, 1st and 2nd backcross progeny were fertile when crossed with P. scurigera. Males of both species had 30 pairs of chromosomes.

## 5505 Metabolism

*REFER ALSO TO CITATION(S) 5505007426, 7509*

**7442 (LBL—18700) Chemical Biodynamics Division annual report, July 1982-June 1984.** (Lawrence Berkeley Lab., CA (USA)). Nov 1984. Contract AC03-76SF00098. 78p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85003472.

Research progress is reported in the following areas: (1) structure and organization of photosynthetic membranes; (2) photosynthetic light reactions; (3) mechanism of water oxidation and oxygen evolution; (4) regulation of photosynthetic carbon metabolism; (5) hydrocarbons from plants; (6) photo-induced oxidation-reduction processes at phase boundaries; (7) the chemistry of electronically excited molecules; (8) picosecond photochemistry; (10) understanding a photosynthetic gene cluster; (11) light reaction of nuclear and chloroplast gene expression; (12) cellular oncogene expression during the cell cycle; (13) carcinogen induced changes in the fluidity of the genome; (14) molecular and cellular parameters associated with the onset of cancer; (15) fundamental chemistry of mutagenesis; and (16) structural biophysics. (ACR)

**7443 Radical pair state in photosystem II: (photosynthesis/electron paramagnetic resonance/electron transfer/pheophytin/donors).** Rutherford, A.W.; Thurnauer, M.C. (Univ. of Illinois, Urbana). *Proceedings of the National Academy of Sciences of the United States of America;* **79**: 7283-7287(Dec 1982). Contract W-31-109-ENG-38.

A stable light-induced EPR signal is reported in photosystem II particles and in chloroplasts at 5K. Characteristic spectral features indicate that the signal arises from dipole-dipole interactions of a radical pair triplet state. From its dependence on potential, its relationship to the spin-polarized triplet state, and the redox state of the pheophytin acceptor (Ph) and because it is present in Tris-washed chloroplasts but not in untreated chloroplasts, we conclude that the signal is formed when the reaction center is in the state $D^+P_{680}Ph^-$ ($P_{680}$ is the primary chlorophyll donor and $D^+$ is an oxidized donor to $P_{680}$). The low-temperature photochemical sequence is thought to occur as follows. (i) Donation from D to the $P_{680}^+Ph^-$ state occurs at liquid helium temperature in low quantum yield; this reaction is reversible at temperatures above 5 K. (ii) In normal chloroplasts, donation occurs to the $D^+P_{680}Ph^-$ state, but this does not occur in Tris-washed chloroplasts or in the photosystem II particles at 77 K or lower. (iii) Illumination, at 200K, of photosystem particles or Tris-washed chloroplasts results in donation to the $D^+P_{680}Ph^-$ state from another donor. From experiments in the absence of redox mediators and the temperature dependence of the splitting of the signal, it is suggested that the state $D^+P_{680}Ph^-$ itself may be the origin of the radical pair triplet signal. The signal has been simulated by assuming the presence of at least two distinct radical pairs that differ slightly in the distance separating the radicals of the pairs. The distance between the radicals of the pair is calculated to be 6-7 A.

## 5506 Medicine

*REFER ALSO TO CITATION(S) 5506007477*

**7444 (BMFT-FB-T—84-149) Hyperlipoprpteinemia and accuracy of the results from radioimmunological procedures.** Dwenger, A. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Medizinische Hochschule Hannover (Germany, F.R.). Abt. Klinische Biochemie). Jul 1984. 45p. (In German). NTIS (US Sales Only), PC A03/MF A01. File Number DE84752284.

So far the comparability of results from different radioimmunological methods does not meet the common standards of quality. This should be improved by systematically investigating disturbing factors, here the influences of lipids/lipoproteins on typical insulin and digoxin radioimmunoassay procedures. Gross disturbances of particular methods should be recognized and removed and such systematic investigations may contribute to the development of reference methods by new types of EQCS. By the employment of radioimmunological digoxin and insulin assays 380 serum samples from patients with primary and secondary hyperlipoproteinemia have been investigated within two years. Identical reagents and test conditions were used to perform the assays with the only exception of the separation techniques (Dextran/charcoal-DC; Coated-Tube-CT; polyethylenglycol-PEG; sodium sulphite-$Na_2SO_3$; double antibody-DAB). The correlations between the serum antigen concentrations (with and without addition of antigen) and the cholesterol/triacylglycerol concentrations of the serum samples as well as the results of recovery, intra- and interassay precisions demonstrate that serum samples could be measured without any disturbance by all methods of each antigen up to serum cholesterol concentrations of

14 mmol/l and triacylglycerol concentrations of 10 mmol/l. Furthermore, from the results of physiologic serum samples it could be demonstrated that interserial deviations or drifts could be lowered by an individual correction control which is performed with each series. By this, the comparability of the results could be improved.

7445 (INIS-mf—9071, pp 12) **Comparison of the dose rates of various types of diagnostic X-ray generators from radiation protection aspects.** Porubszky, T. (Medicor Muevek, Budapest (Hungary)). 1984. (In Hungarian). NTIS (US Sales Only), PC A04/MF A01. File Number TI85780132. (CONF-8404195—Summ.).

From Training course on radiation protection; Balatonkenese, Hungary (11 Apr 1984).

7446 **(INIS-mf—9119) Efficiency of computerized tomography in comparison with other neuroradiological investigation methods.** Kretzschmar, H. (Mainz Univ. (Germany, F.R.). Fachbereich Medizin). 28 Nov 1979. 141p. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number DE85780138.

Computerized tomography is considered to be a decisive and the most reliable investigation method for the diagnosis of cerebral tumors. The rate of detection of intracranial blastomas is over 90%. Supratentorial growths are more easy to prove than tumors at the posterior cranial fossa. In the group of patients examined, 97.3% of the cerebral tumors were confirmed by computerized tomography: 98.7% of these were located above the tentorium and 89.3% under the tentorium. But the diagnostic value of computerized tomography is not only due to the high growth detection rate but also to its informative power as regards the position of growths in relation to vital centres, the type of the blastomas and their space-occupying effect. Thus this investigation method permits to evaluate the complex "space occupation" at one glance. By the angiographic method cerebral growths are confirmed in 86% of the cases; 88.6% of these are located above the tentorium.

7447 (INIS-mf—9122, pp 149-174) **Organisational fundamentals of medical care in catastrophes.** Ahnefeld, F.W. 1983. (In German). NTIS (US Sales Only), PC A11/MF A01. File Number TI85780137. (CONF-8305225—).

From 32. annual meeting of the Schutzkommission beim Bundesministerium des Innern; Ulm, F.R. Germany (1 May 1983).

The author presents definitions, considerations, and fundamentals of discussion. He starts by listing the institutions, equipment and training required for medical care and life-saving services in cases of emergency. A central coordination service for medical care and life saving is proposed. The present situation is reviewed, future needs are stated, and the necessary components of a medical service are listed.

7448 **(INIS-mf—9156) Pharmacokinetics and organ distribution of $^{125}$I-aprindine.** Becker, H. (Freie Univ. Berlin (Germany, F.R.). Medizinische Fakultaet). 21 Jul 1981. 37p. (In German). NTIS (US Sales Only), PC A03/MF A01. File Number DE85780172.

An attempt was made to label aprindine hydrochloride with I-125 by means of an exchange reaction. Organ distribution was determined in 10 rats where radioactivity was measured in the lung, heart, liver, kidney, spleen, brain, transverse muscle tissue and bone sections 5, 10, 30 and 60 min following i.v. injection. The high organ concentration was found in the lung, and also the maximum ratio organ: blood radioactivity was found for this organ. Whole body activity measurements revealed a half-life of nearly 6 hr. Excretion occurred primarily via the faeces. The pharmacokinetic properties of $^{14}$C- and $^{125}$I-aprindine hydrochloride do not therefore differ significantly. A whole body scintiscanning was carried out on an additional 12 rats and 6 rabbits. This revealed a marked enrichment in the lung compared to other organs in the time period 5 to 10 min. An image of relatively good quality was obtained compared to that of conventional perfusion scintiscanning with $^{131}$I-HSA. It is assumed that $^{125}$I-aprindine hydrochloride is concentrated in the lung parenchyma and is therefore largely unaffected by the immediate perfusion conditions. This is also confirmed in preliminary studies with $^{131}$I-aprindine in the scintiscanning of rabbits where voids of pneumonia activity are shown in the aprindine scintigram whereas with the perfusion method these are not. As expected, the reverse was shown to be true following experimental pulmonary embolism where voids were seen in the perfusion scintigram whilst the $^{131}$I-aprindine scintigram revealed hardly any areas of drops in activity. These properties possibly offer an improved diagnostic procedure for differentiating between pneumonia and lung infarct by combination with perfusion scintiscanning.

7449 **(INIS-mf—9158) Investigations on the kinetics of sup(99m)Tc methylene diphosphonate with particular consideration given to quantitative skeletal whole-body scintigraphy.** Buehler, M. (Tuebingen Univ. (Germany, F.R.). Medizinische Fakultaet). 1981. 68p. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE85780173.

Within the framework of this investigation the kinetics of sup(99m)Tc methylene diphosphonate was studied in 15 patients. A normal scintiscan was drawn up from a number of unremarkable single scintiscans to serve as a mean. The plasma activity curve was biexponential in character. The two compartments are expressed by two different half-lives. A half-life of 16.81 min was found for the fast compartment and a half life of 132.63 min for the slow one. The central volume amounted an average to 6.68 l, the distribution volume in equilibrium 13.96 l and the clearance 96.69 ml/min. Nuclide excretion via the kidneys was determined from two urine samples. On average, 47.51% of the dose was excreted after 2 hr and 61.24% after 4 hr. Via a double detector system whole-body scintiscans were completed in the mean scan time of 3.64 hr p.i. These were evaluated according to the principle of the geometrical mean with subsequent norming and proportionation. A normal scintigram derived from unremarkable whole body scintigrams was taken as mean and presented optically in qualitative terms and mathematically in quantitative terms. The accuracy of whole body activity measurement is achieved by correlating measured whole-body activity with the whole-body activity expected following urination. The substance, apparatus and results are discussed.

7450 **(INIS-mf—9165) Frequency and degree of severity of coronay artery sclerosis in patients with angiographically established coronary heart disease.** Hartmann, F.X. (Muenchen Univ. (Germany, F.R.). Fakultaet fuer Medizin). 13 Nov 1981. 78p. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE85780164.

As seen from the literature, only few exact investigations were made concerning the importance of coronary sclerosis in angiographically proven significant coronary artery stenoses. Therefore, patients were examined who had undergone a coronary angiography to find out the sensitivity and specificity of coronary calcification to the diagnosis of coronary heart disease. The author compared these results to the incidence of coronary artery calcification in a random control group of patients. Furthermore the question was discussed whether the degree of severity of coronary sclerosis correlates with the degree of severity of coronary heart disease, taking into consideration age and sex of the patients and the share of vascular diseases affecting one or several vessels.

7451 **(INIS-mf—9166) Myocardial scintiscanning with intravenously injected thallium 201 as a control parameter in aneurysmectomies after transmural anterior wall infarctions.** Groeber, L. (Tuebingen Univ. (Germany, F.R.). Medizinische Fakultaet). 1981. 81p. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE85780174.

This investigation covers patients who, afer an aneurysmectomy, could not be examined by means of non-invasive scintiscanning. Three patients were also additionally examined by means of myocardial scintiscanning with thallium 201 before surgery. The main concern of this investigation was to find out if and how a homogenously storing left ventricle can be restored by means of aneurysmectomy. Tl-201-scintiscanning can, as the only non-invasive method, provide operation-relevant information in diagnosing, due to the possibility of exact localisation and expansion, as well as the assessment of the residual myocardium. Especially in the region of the apex of the heart, there were significantly more positive findings than in exercise ECG. Furthermore, Tl-201-scintiscanning is also suitable as a control examination and for course control by im-

aging the myocardium, due to its being independent of the time of the myocardial infarction.

7452 **(INIS-mf—9167) Osteomyelofibrosis - skeletal changes which can be determined by X-ray examination and histopathological classification of these changes.** Tonon, H. (Freie Univ. Berlin (Germany, F.R.). Medizinische Fakultaet). 7 Nov 1981. 67p. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE85780165.

The following aspects of osteomyclofibrosis were investigated and discussed in this paper: What are the types, frequency rates, and distribution rates of bone changes which can be determined radiologically and how can they be defined by means of differential diagnosis. Can an individual quantitative and/or qualitative progression of these changes be found. Are these changes correlated with histological changes in the biopsies.

7453 **(INIS-mf—9168) Coronary angiographic findings in diagnostically manifested myocardial infarctions: Their relationship to psychosocial and somatic risk factors.** Waschk, O. (Marburg Univ. (Germany, F.R.). Fachbereich Humanmedizin). 1981. 118p. (In German). NTIS (US Sales Only), PC A06/MF A01. File Number DE85780166.

The investigation was meant as an attempt to illustrate coronary arteriosclerosis as the cause of myocardial infarction and the mechanisms of its development as well as the conditions influencing it. The paper consists of two parts: 1) Literature part: In this part, risk factors of coronary arteriosclerosis and the mechanism of its effects (as far as known) are introduced. The results obtained by other authors are also summarized. 2) Empiric part: The following empiric part covers the author's own results which are discussed and compared to the results obtained by other authors.

7454 **(INIS-mf—9170) Diagnosing diseases of the thyroid gland by means of scintiscanning and puncture cytology taking into consideration the nodular goitre.** Eitel, M. (Technische Univ. Muenchen (Germany, F.R.). Fakultaet fuer Medizin). 20 May 1981. 119p. (In German). NTIS (US Sales Only), PC A06/MF A01. File Number DE85780175.

This paper contains the results of scintigraphical and puncture-cytological examinations carried out during an observation period of appr. 3 years on 548 patients with goiters from the Upper-Bavarien endemis region. In total, we had 484 thyroid gland scintigrams which showed 335 uninodular, 71 multinodular, and 78 diffuse goiters. The 335 solitary nodular goiters were allocated 278 cold, 36 warm, and 18 hot nodes; in three cases, the scintigram could not be assessed due to exogenous iodine contamination. In the 71 multinodular goiters, we found 118 cold, 28 warm, and 9 hot nodes. Cytological findings were established in 548 patients. In 484 cases, the findings were negative, in 19 cases suspicious, and in 17 cases positive. The efficiency of cytological diagnosis of malignant tumours can be stated to be 87.5%. The rate of falsely negative smears was 12.5%; cytologically, in 10.9% of the preparations falsely suspicious diagnoses were established, and in 1.6% the diagnoses were falsely positive.

7455 **(INIS-mf—9171) Nuclear-medical examination of the ureteric peristalsis with sup(99m)Tc-MDP as an additional finding to the bone scintigrams of patients with healthy kidneys.** Lindenberger, R. (Tuebingen Univ. (Germany, F.R.). Medizinische Fakultaet). 1981. 42p. (In German). NTIS (US Sales Only), PC A03/MF A01. File Number DE85780176.

A new nuclear-medical examination method is described at 42 patients. In order to obtain more exact information about the mobility of the ureter the Urokinetogram (UKG) developed by Mueller-Schauenburg was prepared and evaluated after a routine serial renal scintiscanning with sup(99m)Tc-MDP. The results of the examination were interpreted and, in addition to that, also the left and right ureter separately after drinking tea and in separate groups according to the sex of the patients. .

7456 **(INIS-mf—9172) Myocardial scintiscanning with Thallium-201 in assessing the sucess of aortocoronary bypass surgery.** Gauss, A. (Tuebingen Univ. (Germany, F.R.). Medizinische Fakultaet). 1981. 119p. (In German). NTIS (US Sales Only), PC A06/MF A01. File Number DE85780177.

The objective of this investigation was to review the value and reproducibility of this method as a non-invasive examination to assess the success of in terms of perfusion improvement aortocoronary bypass surgery. This was done on 40 patients (25 of these were examined with thallium-myocardial scintiscanning before and after surgery and 15 only after surgery). This is to be compared with the exercise ECG and with coronary angiography, as well as with the clinical findings after surgery.

7457 **(INIS-mf—9173) Use of computed tomography in the differential diagnosis of late epilepsy.** Annewanter, B. (Freie Univ. Berlin (Germany, F.R.). Medizinische Fakultaet). 20 Jul 1981. 141p. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number DE85780167.

The report refers to 299 patients suffering from late epilepsies who were examined both clinically and by computed tomography. The cases were classified according to clinical tentative diagnoses and types of attacks. The objective was to find out how useful computerized tomography is in differential diagnosis concerning the aetiology of late epilepsies.

7458 **(INIS-mf—9175) Angiographic determination of the left-ventricular myocardial volume with the help of digital image processing.** Radtke, W. (Kiel Univ. (Germany, F.R.). Medizinische Fakultaet). 28 Sep 1981. 55p. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE85780168.

In this paper, digital image processing could for the first time be introduced as a new method to screen the myocardium in the left-ventricular angiocardiography. The method makes a reliable quantitative determination of the muscle mass of the left ventricle possible.

7459 **(INIS-mf—9176) $^{67}$GA-citrate scintiscanning for the staging and course contral of the Hodgkin's disease.** Baecher, F.M. (Technische Univ. Muenchen (Germany, F.R.). Fakultaet fuer Medizin). 12 Feb 1982. 100p. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE85780178.

266 $^{67}$Ga scintigrams of 93 patients in treated and untreated states were evaluated and compared to the histological, radiological, and clinical data. A difference in the storing characteristics of the various histological subtypes of lymphogranulomatosis could not be proven. In the intrathoracic space, radiogallium scintiscanning is of the same value as radiological diagnosing due to its congruency with the X-ray picture in 88.6% of the untreated and 94.2% of the treated cases. Comparing to the X-ray picture, radiogallium scintiscanning provides also additional information: a statement concerning the vitality of the Hodgkin tissue thus informing also about the efficiency of the treatment carried out. After an effective radio or chemotherapy, the scintigraphs show no more scintigraphically provable storing foci. In the abdominal region, the method does not permit to make sufficient statements on affection of liver, spleen, or the abdominal lymph node stations. For our group of patients, we calculated 0.3% falsely positive and 4.0% falsely negative results. The results we obtained emphasize the value of $^{67}$Ga-scintiscanning in the primary staging and therapy control of the morbus Hodgkin as well as in diagnosing relapses.

7460 **(INIS-mf—9177) Pulmonary emphysema in postmortem angiograph.** Duisberg, W. (Technische Hochschule Aachen (Germany, F.R.). Medizinische Fakultaet). 6 Oct 1981. 64p. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE85780169.

33 postmortal angiographs of lungs with panlobular, centrilobular, perinodular, and bullous emphysemas were reviewed. In these angiographs, the pulmonary artery, the apical segment artery, the lower lobe artery, the basomedial and basolateral segment artery is shown clearly with its branchings up to the terminal arteries. In each of the angiographs, the course of the vessel, its width,

its reduction, branching angle, the density of the vessels, the contour, the shunts, and the total architecture were investigated and classified according to the individual emphysema forms and these were compared to each other. It was seen that the postmortal angiography of the 2 mm thick prepared slice of the lung centre offers a good possibility of assessing all vessel sizes of the lung vessel tree. On these angiographs, we could prove a typical change in the pulmonary arteries of all sizes in dependence on four emphysema forms.

7461 **(INIS-mf—9178) Value of angiography in the differential diagnosis of renal failure.** Helber, B. (Muenchen Univ. (Germany, F.R.). Fakultaet fuer Medizin). 26 Nov 1981. 89p. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE85780170.

93 cases of kidneys which had been found to be not functioning in the excretion urography were examined with regard to the correctness of the angiographic diagnosis. We conclude from the results that in case of a renal failure in patients with a satisfactory general condition, renal arteriography is the method to be chosen to recognize the causes of the failure. Furthermore, preexaminations are necessary for the surgical elimination of the clinical symptoms; here, renovasography is definitely the most efficient examination method.

7462 **(INIS-mf—9180) Importance of angiography in cases of growing and displacing processes in the adrenal glands.** Hauer, E. (Freie Univ. Berlin (Germany, F.R.). Medizinische Fakultaet). 29 Jun 1981. 173p. (In German). NTIS (US Sales Only), PC A08/MF A01. File Number DE85780171.

The objective of this investigation was to compare the distribution of the individual diagnoses concerning 45 patients angiographed with the diagnosis "suspected growing and displacing process in the adrenal gland" to the literature. The investigation also covered the question of whether the angiographic vessel patterns permitted to draw conclusions concerning the type of growing and displacing process. This group of 45 patients had been selected out of a collective of 101 patients who had been examined and whose angiographic diagnosis had been manifested either by an operation or by a resection. Finally, the most favourable diagnostic procedure in the various forms of tumours of the adrenal gland was discussed. The position of angiography in relation to sonography, scintiscanning, and computerized tomography was clarified.

7463 **(LBL—17781) Matrix-based image reconstruction methods for tomography.** Llacer, J.; Meng, J.D. (Lawrence Berkeley Lab., CA (USA)). Oct 1984. Contract AC03-76SF00098. 12p. (CONF-841007—31). NTIS, PC A02. File Number DE85003468.

From Nuclear science symposium; Orlando, FL, USA (31 Oct 1984).

Matrix methods of image reconstruction have not been used, in general, because of the large size of practical matrices, ill condition upon inversion and the success of Fourier-based techniques. An exception is the work that has been done at the Lawrence Berkeley Laboratory for imaging with accelerated radioactive ions. An extension of that work into more general imaging problems shows that, with a correct formulation of the problem, positron tomography with ring geometries results in well behaved matrices which can be used for image reconstruction with no distortion of the point response in the field of view and flexibility in the design of the instrument. Maximum Likelihood Estimator methods of reconstruction, which use the system matrices tailored to specific instruments and do not need matrix inversion, are shown to result in good preliminary images. A parallel processing computer structure based on multiple inexpensive microprocessors is proposed as a system to implement the matrix-MLE methods. 14 references, 7 figures.

7464 **(NIRS-M—38) Proceedings of 12th NIRS seminar on progress of isotope tracer techniques in biology and basic medicine.** (National Inst. of Radiological Sciences, Chiba (Japan)). 1982. 286p. (In Japanese). (CONF-8012126—). NTIS (US Sales Only), PC A13/MF A01. File Number DE85780072.

From 12. NIRS seminar on progress of isotope tracer techniques in biology and basic medicine; Anagawa, Chiba, Japan (4 Dec 1980).

Items within the scope of EDB have been entered individually into the data base. (ACR)

7465 **Detection of ocular melanoma with 4-(3-dimethylaminopropylamino)-7-[$^{123}$I]-iodoquinoline.** Lambrecht, R.M.; Packer, S.; Wolf, A.P.; Lloyd, D.; Atkins, H.L. (Brookhaven National Lab., Upton, NY). *Journal of Nuclear Medicine;* **25**: No. 7, 800-804(Jul 1984).

Iodine-123-labeled 4-(3-dimethylpropylamino)-7-iodoquinoline was evaluated in nine patients. By using a specially designed dual-pinhole ocular collimator, it was possible to obtain positive images at 2-6 hr for only 70% of the cases with subsequently proven ocular melanomas.

7466 **On-line characterization of heavy-ion beams with semiconductor detectors.** Llacer, J.; Tobias, C.A.; Holley, W.R.; Kanai, T. (Lawrence Berkeley Laboratory, CA). *Medical Physics;* **11**: No. 3, 266-278(May-Jun 1984).

Heavy-ion beams used in biomedical studies suffer a substantial amount of nuclear reactions (fragmentation) as they traverse matter. Since it has been demonstrated that dose and linear energy transfer (LET) are not a sufficient description of a beam for the purpose of understanding its biological effects, it is necessary to be able to separate the components of a complex beam so that their individual effects can be analyzed. A simple and small assembly consisting of a thin silicon LET detector, in time coincidence with a thick germanium residual energy detector has been used in measurements of the components of Ne-20 and Si-28 high-energy ion beams. The detector system can be placed at any experimental area without difficulty and it can carry out a beam analysis in a few minutes, making it very appropriate for fast on-line measurements and verification of beam characteristics. LET values measured by the silicon detector agree well with results of the Bethe stopping-power calculations, and the dose measured for the beam components can be used to obtain Bragg curves that are in good agreement with those obtained by ionization chamber measurements on the same beams. The numbers and LET distribution of primaries and fragments at different positions of the Bragg curves, as well as fractional dose contributed by the different components are determined directly from the experimental data. Particle velocity distributions can be obtained for the higher Z fragments. Limitations and advantages of the simple measurement technique are discussed.

7467 **Oxygen tension regulates the expression angiogenesis factor by macrophages.** Knighton, D.R.; Hunt, T.K.; Scheuenstuhl, H.; Halliday, B.J.; Werb, Z.; Banda, M.J. (Univ. of California, San Francisco). *Science (Washington, D.C.);* **221**: 1283-1285(23 Sep 1983). Contract AC03-76SF01012.

When cultured in a hypoxic environment similar to that found in the center of a wound, macrophages secreted active angiogenesis factor into the medium. Under conditions similar to those of well-oxygenated tissue, macrophages did not secrete active angiogenesis factor. Macrophages that secreted the factor at hyposic conditions stopped secreting it when returned to room air. Thus the control of angiogenesis in wound healing may be the result of macrophages responding to tissue oxygen tension without the necessity of interacting with other cell types or biochemical signals.

## 5507 Microbiology

*REFER ALSO TO CITATION(S) 5507006554, 6555, 6921*

## 5508 Morphology

7468 **Ultrastructure of the accessory glands of the Mediterranean flour moth.** Riemann, J.G.; Thorson, B.J. (Dept. of Agriculture, Fargo, ND). *Journal of Morphology;* **159**: No. 3, 355-391(Mar 1979).

Five regions are recognized in the accessory glands of the Mediterranean flour moth, Anagasta kuehniella (Zeller), on the

basis of cellular morphology and aggregates of secretory material in the lumen. Some variation is found in each of the posterior four regions, especially the third one. In the most anterior region (region 1) the epithelium is composed of a single type of cell, while in each of the other regions there are two classes of cells. The cells of region 1 and one class in each of the other four regions are fairly typical exocrine cells with extensive rough endoplasmic reticula. Secretion is primarily via Golgi-derived vesicles. Apocrine secretion in the form of sloughing off of the apical cytoplasm probably also occurs in all regions but is most prominent in the posterior two regions. One class of cells is very similar in morphology in each of the posterior four regions though their secretory products form characteristic aggregates in the lumen. The second class of cells (foliate cells) occurring in the posterior four segments is most notably characterized by elongate apical projections that extend out into the lumen. The apical projections contain large quantities of glycogen, some microtubules, and, in some cases, many minute mitochondria. The membrane content of the projections is also very high. In the anterior regions, the membranes are mostly fused in pairs and typically form multilayered whorls. Fusion and whorl formation decrease in the posterior regions. The cytoplasm of the foliate cells has a high organelle content including many lysosomes and mitochondria. The apical projections of the foliate cells are detached during copulation, presumably as the result of nervous stimulation, and become a part of the ejaculate. Replenishment of all secretory material, including the apical projections, occurs after copulation.

7469 **Foliate and granule-secreting cells in the ejaculatory duct (simplex) of the Mediterranean flour moth.** Riemann, J.G.; Thorson, B.J. (Dept. of Agriculture, Fargo, ND). *Journal of Ultrastructure Research;* **66**: 1-10(1979).

The epithelium of the first segment of the unpaired ejaculatory duct (simplex) of the Mediterranean flour moth, Anagasta kuehniella (Zeller), is composed of two types of cells. One type is a typical secretory cell that releases large numbers of granules into the lumen. The other type of cell (foliate cell) forms elongate apical projections that are composed mostly of membranes. The membranes are typically fused in pairs (along their outer surfaces) and form complex multilayered whorls. During copulation the apical projections are split off to become a part of the ejaculate and eventually form a major part of the wall of the male's spermatophore. The apical projections of the foliate cells and the supply of secretion from the other type of cell are renewed after copulation.

## 5509 Pathology

*REFER ALSO TO CITATION(S) 5509007491*

## 5510 Physiological Systems

7470 **Recovery of fertility by Mediterranean flour moths transferred from continuous light to light:dark.** Riemann, J.G.; Johnson, M.; Thorson, B. (Dept. of Agriculture, Fargo, ND). *Annals of the Entomological Society of America;* **74**: No. 3, 274-278(May 1981). Contract AI01-79EV10094.

Male Mediterranean flour moths, Anagasta kuehniella (Zeller), placed in continuous light (LL) from the early pupal stage on were partially sterile as adults. When old adult moths were transferred to alternating light and dark (LD), fertility was not recovered, but fertility was recovered when fairly young males were similarly transferred. Multiple matings of males indicated that recovery was correlated with sperm in the testes at the LL to LD transfer becoming available for ejaculations. Few morphological abnormalities were found in the sperm of LL males, but there was less activity than in the sperm of LD males. At 1 week after eclosion, the testes of LL males contained more sperm bundles than did the testes of LD males, but the LL males had somewhat fewer bundles overall in their reproductive tracts. Disruption of the circadian rhythm regulating movement of sperm from the testes was suggested as the most probable cause of the sterility of LL males.

## 5530 Agriculture And Food Technology

*REFER ALSO TO CITATION(S) 5530007043, 7044, 7045, 7046, 7047, 7048, 7049, 7369, 7395*

# 56 BIOMEDICAL SCIENCES, APPLIED STUDIES

## 5601 Radiation Effects

*REFER ALSO TO CITATION(S) 5601107439*

7471 (FS—83-32-T, pp 85-96) **Detection of radioactive contaminations on occupationally exposed persons by means of film-dosemeters.** David, J. Nov 1983. (In German). Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland). (CONF-8306168—).

From 17. annual meeting of Fachverband fuer Strahlenschutz e.V.; Aachen, F.R. Germany (8 Jun 1983).

The Personal Monitoring Office of GSF, being the measuring office in accordance with Para. 63 (3) sentence 1 of the Radiation Protection Ordinance (StrlSchV) and Para. 40 (2) sentence 4 of the X-Ray Ordinance (RoeV) has to inform the responsible authorities about noticeable radioactive contamination of radiation workers as well as the exceedings of individual dose levels. Contamination can be detected by the official film-dosemeters, when the dosemeter used is contaminated. The auto-radiogramm produced on the detector-film by the radioactive substances on the surface of the dosemeter shows a density pattern dependant on the type, the distribution and the activity of the contaminating radioactive isotope and the acting time. Examples of contaminations on the detector-film are shown. Problems occur with the identification and the kind of additional information about the contaminations. It is difficult to make quantitative statements on the type and the activity of the contaminating radioactive isotopes. Nevertheless an attempt is made to define the sensitivity of the method. The results of the measuring office, which handles 60.000 film-dosemeters monthly, are checked for contaminations and are analyzed statistically under different aspects such as information about radioactive isotopes used, description of the working place, the field of employment and other additional information.

7472 (FS—83-32-T, pp 99-106) **Benefit-risk considerations for the decontamination of persons, from a medical point of view.** Heinemann, G. Nov 1983. (In German). Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland). (CONF-8306168—).

From 17. annual meeting of Fachverband fuer Strahlenschutz e.V.; Aachen, F.R. Germany (8 Jun 1983).

The paper shows a concept proposed for the decontamination of skin which is based on theoretical considerations and experimental data: If skin comes into contact with powerful allergens, toxic substances or radioactive preparations 1. treat immediately. 2. do not wash with detergent pastes, etc., plus water, even if they have been sold as being suitable for skin decontamination. 3. do not use any solvents. 4. do not rub, do not dilute, but, rather: 5. remove excess with a blunt knife or spatula, etc. 6. spread fat on the residue (Butter, Margarine, Vaseline, lubricating oil, ect.) 7. remove this fat and repeat three times. 8. if possible carry out skin surface stripping ten times, using fresh adhesive tape each time.

7473 (FS—83-32-T, pp 107-123) **Problems related to personnel decontamination in nuclear power plants.** Pawlytsch, S.; Franz, M.; Strauss, W.; Reichert, B. Nov 1983. (In German). Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland). (CONF-8306168—).

From 17. annual meeting of Fachverband fuer Strahlenschutz e.V.; Aachen, F.R. Germany (8 Jun 1983).

Talks between radiation protection specialists showed that their views and knowledge of procedures for decontamination of persons differ greatly and are contrary in some cases. It is therefore necessary to initiate an exchange of experience on the problems of personnel decontamination in the near future. Such an exchange of

experience must specify and answer questions put forth in the lecture.

7474 (FS—83-32-T, pp 125-136) **Computation of dose factors emanating from contamination of skin and clothes.** Henrichs, K.; Kaul, A. Nov 1983. (In German). Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland). (CONF-8306168—).

From 17. annual meeting of Fachverband fuer Strahlenschutz e.V.; Aachen, F.R. Germany (8 Jun 1983).

Contaminations from handling unsealed radioactive substances in nuclear medicine and nuclear engineering are the cause of radiation exposure of contaminated skin (by particle radiation) and of other parts of the body (by platons). Anticipated values for the dose rate were estimated by means of a simple physical model. They are indicated for specific nuclides as dose factors. Anticipated values for the radiation exposure of the skin and of other parts of the body in actually occuring or conceavable contamination incidents are listed.

7475 (FS—83-32-T, pp 137-149) **Radiation exposure anticipated for medical personnel attending contaminated patients.** Kemmer, W. Nov 1983. (In German). Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland). (CONF-8306168—).

From 17. annual meeting of Fachverband fuer Strahlenschutz e.V.; Aachen, F.R. Germany (8 Jun 1983).

The extent of personnel contaminations with radioactive substances in laboratory and operation accidents and the corresponding radiation exposure of doctors and their medical staff is often quite controversial even with experts. In the opinion of many, a radiation accident with radioactive substances may be hazardons to the health of doctors and their medical staff by external irradiation, contamination and incorporation. It is the purpose of this lecture to estimate the extent of possible personal contamination by means of realistic assumptions and maximum credible accidents, and to judge on the radiation exposure of doctors and their medical staff while attending such patients. Accidents that might occur in nuclear power plants, fuel reprocessing plants, waste treatment, fuel element production, in particular with plutonium, handling of radiactive substances in laboratories especially in nuclear medicine, and transport of radioactive substances are analyzed. The courses of accidents listed slow that the radiation exposure of doctors and their medical staff in the attendance of radiation accident patients is negligible even at short distance from the patient. There is no radiation hazard.

7476 (FS—83-32-T, pp 167-174) **Experience with everyday contamination monitoring in a nuclear-medical department.** Anger, K.; Stockberg, H.; Schmachtenberg, A.; Treusacher, P.; Wahlen, M. Nov 1983. (In German). Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland). (CONF-8306168—).

From 17. annual meeting of Fachverband fuer Strahlenschutz e.V.; Aachen, F.R. Germany (8 Jun 1983).

In a nuclear medicine department using sup(99m)Tc and $^{131}I$ almost exclusively since 1977 2 physicians and 3 nuclear technologists were surveyed every day for contaminations as well as the floor and the working sites of the rooms by an independent physical working group. There were found contaminations of working sites 30 times, of the floor 34 times, of other rooms than the hot laboratory 12 times. Most contaminations were combined and remained beneath 1 MBq. Physicians were contaminated 24 times, technologists 40 times, this is 2,0/physician/year and 2,2/technologist/year. Personal contaminations washed by soap and water however, couldn't be reduced to background in a lot of cases. Contaminations of working sites and floor were washed away superficially, then covered up and couldn't be detected one to three days after.

7477 (FS—83-32-T, pp 175-184) **Aspects of radiation protection in iodine-131 therapy at the nuclear-medical hospital of the University of Duesseldorf on the premises of the Juelich nuclear research plant.** Friedrich, W. Nov 1983. (In German). Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland). (CONF-8306168—).

From 17. annual meeting of Fachverband fuer Strahlenschutz e.V.; Aachen, F.R. Germany (8 Jun 1983).

Patients who are treated with $^{131}$iodine because they suffer from a malignant thyroid carcinoma are monitored for years. The treatment takes place after the operation and will be repeated after a longer period of time corresponding to the course of the illness. For that therapy a capsule of 3.7 GBq (administered dose) is given orally and 2-3 days later another capsule with the same radioactivity. All equipment of the patients room and the patient himself are controlled in a certain routine. On top of that we measured the excrements of the patients. The contamination of the exhalation of the patients was measured. In the exhalation and in determinating the concentration of the air in the room an organically fixed iodine part of 90% was found. The concentration of the air in the room is only 14 hours higher than the permitted concentration of the air in the room in controlled areas of 320 Bq x $m^{-3}$. The release factor of the exhalation was $< 7 \times 10^{-8}$ of the administrated dose. The release factor of the therapy capsule was $< 2 \times 10^{-8}$ times that of the delivered radioactivity of one day. The contamination in the patient's room, in his clothing and in the transport container of is $<$ 80 kBq x $cm^{-2}$ in the average of 100 $cm^2$.

7478 (FS—83-32-T, pp 187-195) **Contamination and decontamination problems in handling tritium.** Riedel, H.J.; Fabian, H.J. Nov 1983. (In German). Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland). (CONF-8306168—).

From 17. annual meeting of Fachverband fuer Strahlenschutz e.V.; Aachen, F.R. Germany (8 Jun 1983).

Tritium, a hydrogen isotope rarely found in nature, is getting increasingly important in the operation of nuclear facilities, in fuel reprocessing, and of late in nuclear fusion technology. Owing to the low mean $\beta$-radiation energy of tritium which is 5.5 keV, there are no problems as to exterior radiation protection, shielding measures are not required. The inhalation of $T_2$ gas is less hazardous than the incorporation of HTO because of extensive exhalation. Yet the detection and monitoring of contamination and incorporation involves problems concerning suitable radiation measurement equipment. Field monitoring as applied with $\gamma$-sources can not be used because of low radiation energy. Personnel monitoring for tritium incorporation can only be done by monitoring the excrements. The diffusion capacity of tritium in any material, at high temperatures in particular, causes serious problems of inclusion of the gas and requires specialized technologies for handling great quantities of tritium. Conventional decontaminations are aggravated by the capacity of tritium to diffuse. The import of these aspects is discussed in the context of the construction and operation of a store for $10^5$ Ci (10 g) tritium.

7479 (INIS-mf—9071, pp 34) **Biological indicators of radiation effects. Demands and opportunities.** Koeteles, G.; Almassy, Z.; Kubaszova, T.; Somosy, Z.; Boeloeni, E. (Orszagos Frederic Joliot-Curie Sugarbiologiai es Sugaregeszseguegyi Kutato Intezet, Budapest (Hungary)). 1984. (In Hungarian). NTIS (US Sales Only), PC A04/MF A01. File Number TI85780132. (CONF-8404195—Summ.).

From Training course on radiation protection; Balatonkenese, Hungary (11 Apr 1984).

7480 (INIS-mf—9071, pp 35) **Investigations on radiotoxicology and incorporation.** Varga, L.; Gundy, S.; Gachalyi, A.; Namenyi, J. (Orszagos Frederic Joliot-Curie Sugarbiologiai es Sugaregeszseguegyi Kutato Intezet, Budapest (Hungary)). 1984. (In Hungarian). NTIS (US Sales Only), PC A04/MF A01. File Number TI85780132. (CONF-8404195—Summ.).

From Training course on radiation protection; Balatonkenese, Hungary (11 Apr 1984).

7481 (INIS-mf—9071, pp 36) **Investigations on the kinetics of iodine uptake and incorporation of radioactive iodine.** Turai, I. (Orszagos Frederic Joliot-Curie Sugarbiologiai es Sugaregeszseguegyi Kutato Intezet, Budapest (Hungary)). 1984. (In Hungarian). NTIS (US Sales Only), PC A04/MF A01. File Number TI85780132. (CONF-8404195—Summ.).

From Training course on radiation protection; Balatonkenese, Hungary (11 Apr 1984).

7482 (INIS-mf—9071, pp 54) **Determination of the concentration factors for strontium and manganese in soil-plant systems.** Bokori, E.; Stur, D. (Orszagos Frederic Joliot-Curie Sugarbiologiai es Sugaregeszseguegyi Kutato Intezet, Budapest (Hungary)). 1984. (In Hungarian). NTIS (US Sales Only), PC A04/MF A01. File Number TI85780132. (CONF-8404195—Summ.).

From Training course on radiation protection; Balatonkenese, Hungary (11 Apr 1984).

7483 (INIS-mf—9071, pp 31) **Evaluation of the radiation exposure of the employees.** Bojtor, I.; Sztanyik, B.L. (Orszagos Frederic Joliot-Curie Sugarbiologiai es Sugaregeszseguegyi Kutato Intezet, Budapest (Hungary)). 1984. (In Hungarian). NTIS (US Sales Only), PC A04/MF A01. File Number TI85780132. (CONF-8404195—Summ.).

From Training course on radiation protection; Balatonkenese, Hungary (11 Apr 1984).

7484 (INIS-mf—9071, pp 25) **Development of the measuring method of internal radiation exposure by means of whole-body counters at the Central Research Institute of Physics (Hungary).** Andrasi, A.; Beleznay, F.; Urban, J. (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). 1984. (In Hungarian). NTIS (US Sales Only), PC A04/MF A01. File Number TI85780132. (CONF-8404195—Summ.).

From Training course on radiation protection; Balatonkenese, Hungary (11 Apr 1984).

7485 **(INIS-mf—9071) Proceedings of the '84 training course on radiation protection held at Balatonkenese, Hungary, 11-13 Apr 1984.** (Eoetvoes Lorand Fizikai Tarsulat Sugarvedelmi Szakcsoportja, Budapest (Hungary)). 1984. 72p. (In Hungarian). (CONF-8404195—Summ.). NTIS (US Sales Only), PC A04/MF A01. File Number DE85780132.

From Training course on radiation protection; Balatonkenese, Hungary (11 Apr 1984).

Items within the scope of EDB have been individually entered into the data base. (ACR)

7486 **(INIS-mf—9089) Research Institute ITAL. Association EURATOM ITAL. Annual report 1982.** (Instituut voor Toepassing van Atoomenergie in de Landbouw, Wageningen (Netherlands); Association Euratom-ITAL, Wageningen (Netherlands)). 1983. 81p. NTIS (US Sales Only), PC A05/MF A01. File Number DE85780152.

The Research Institute ITAL is one of the institutes of the Division for Agricultural Research of the Dutch Ministry of Agriculture and Fisheries. For certain aspects of its programme it is also a partner in the Association EURATOM-ITAL with the Commission of the European Community. This annual report deals with: molecular genetic methods for plant breeding; biotechnical production of valuable compounds by means of (plant) cell cultures and microorganisms; soil biology including the rhizosphere; radioactive contamination of the environment and its public health risks; the synergistic interaction between radiation and other mutagenic agents; a new approach in malaria control by means of radiation genetic research on insects; genetic sexing in the Mediterranean fruitfly, Ceratitis capitata; food irradiation (activities within the contract of the Dutch Government with the IAEA in Vienna and the FAO in Rome on food irradiation technology for developing countries).

7487 (INIS-mf—9122, pp 197-203) **Effects of radioprotective agents on mammal cells.** Schuessler, H.; Pauly, H. (Erlangen-Nuernberg Univ., Erlangen (Germany, F.R.). Inst. fuer Radiologie). 1983. (In German). NTIS (US Sales Only), PC A11/MF A01. File Number TI85780137. (CONF-8305225—).

From 32. annual meeting of the Schutzkommission beim Bundesministerium des Innern; Ulm, F.R. Germany (1 May 1983).

The effects of aminothiols and thiophosphates on cultures of B14 Chinese Hamster cells were investigated. 30 min before irradiation, the cells were covered with a solution of the radioprotective agent. After irradiation, this solution was removed and substituted by culture medium. The radioprotective effect increases with increasing cystamine concentrations. With a cystamine concentration of 60 mM, a dose reduction factor of 3 was achieved. Further investigations showed that already after 2 min of incubation, the radioprotective effect in the same as after 60 min.

7488 (INIS-mf—9122, pp 189-195) **Residual insufficiency of hematopoiesis after acute or chronic exposure to gamma radiation or neutrons.** Wangenheim, K.H. v.; Peterson, H.P.; Feinendegen, L.E. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Medizin). 1983. (In German). NTIS (US Sales Only), PC A11/MF A01. File Number TI85780137. (CONF-8305225—).

From 32. annual meeting of the Schutzkommission beim Bundesministerium des Innern; Ulm, F.R. Germany (1 May 1983).

Recovery of the stem cell quality is possible after acute exposure to 500 rad $\gamma$ radiation up to a period of 6 months. Beyond this data, a significant residual damage remains. The same applies to quantitative stem cell recovery. Chronic $\gamma$ exposure leads to less radiation damage than acute exposure. After a total accumulation of 500 rad, the proliferation factors after chronic exposure were, on an average 20% higher than after acute radiation exposure. 6 MeV neutron exposure reduced the stem cell quality and stem cell count much more efficiently than $\gamma$ exposure. The relative biological effect of neutrons is at least 2.5 times as high as the $\gamma$ effect, both for the stem cell count and the stem cell quality.

7489 (INIS-mf—9122, pp 175-187) **Midhead and gastrointestinal doses in tactical nuclear environments.** Schaenzler, L. (Bundeswehr, Munster (Germany, F.R.). Wehrwissenschaftliche Dienststelle fuer ABC-Schutz); Scott, W.; Kaul, D. (Science Applications, Inc., La Jolla, CA (USA)). 1983. NTIS (US Sales Only), PC A11/MF A01. File Number TI85780137. (CONF-8305225—).

From 32. annual meeting of the Schutzkommission beim Bundesministerium des Innern; Ulm, F.R. Germany (1 May 1983).

The calculations were performed for a standing and a prone man at four different orientations to the burst and at two different ranges. The detailed nature of the calculations allowed the determination of the transmitted neutrons, the transmitted gamma-rays and the gamma-rays produced by neutron interactions in the human body. The corresponding transmission factors do not vary too much with orientation or range, but are very different for the head and the intestine. For instance only 13% of the free field neutron dose reach the GI tract, but 43% reach the midhead position. Most of the dose at the GI tract consists of gamma-rays even at high n/$\gamma$ free field dose ratios. The calculations permit an easy computation of any critical organ dose, if neutron and gamma doses were recorded by a dosimeter.

7490 **(INIS-mf—9174) Influence of a tumour bed pre-irradiation on the growth and proliferation of the Harding-Passey melanoma of mice.** Holler, E. (Muenchen Univ. (Germany, F.R.). Fakultaet fuer Medizin). 20 Oct 1981. 130p. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number DE85780160.

In this investigation we dealt with the influence of an isolated tumour bed pre-irradiation on the macroscopic growth at the Harding-Passey melanoma of NMRI-mice, preparing a differentiated time course of the tumour bed effect (TBE) observed. The influence on growth of TBE is compared with the growth slow-down after in-situ irradiation which has considerable influence on the radiobiological experiment of the measurement of delayed growth. In parallel to the macroscopic growth measurements, the effects of the TBE on the histogenesis, the composition of the tissue, and the proliferation behaviour of the Harding-Passey melanoma are analysed in various growth phases. The general importance of the TBE in tumour irradiation, but also its value as a system suitable to test the radiation effects on the vascular connective tissue are pointed out.

7491 **(INIS-mf—9179) Acute and delayed radiation injuries in the small intestine and colon. Etiology, pathogenesis, clinical aspects and therapy.** Heiss, H. (Mainz Univ. (Germany, F.R.). Fachbereich Medizin). 1981. 114p. (In German). NTIS (US Sales Only), PC A06/MF A01. File Number DE85780161.

The group of patients with severe actinic intestinal injuries consists of 67 patients, 46 female and 21 male. The main indication of irradiation were gynaecologic tumours with 67%. The irradiation was carried out with a telekobalt unit combined with radium. From the pathogenetic point of view, acute inflammation and necrobiotic processes in the intestinal mucosa and a restriction of the ability to regenerate are the main radiation-induced acute injuries; delayed injuries are mainly the narrowing and rarefaction of the vessels with lacking capillary budding. The cause of the completely different intervals of up to 26 years until the manifestation of the delayed injury remained unclear. The majority of the delayed symptoms were unspecific; therefore, the danger of misinterpretation was pointed out. A resection with primary anastomosis of the ends of the intestines is the goal to be reached operation-technically. The postoperative complication rate was 45.0%. The most frequent complications were the recurrence of a fistula and the formation of a new fistula, respectively, followed by anastomotic and wound insufficiency, and gastrointestinal bleedings. The postoperative lethality was 18.3%. The causes of death were, according to their frequency, peritonitis, acute failure of the coronary circulation, pneumonia, and massive bleedings.

7492 **(INIS-mf—9181) Autoradiographical investigations of the proliferation of gynaecological carcinomas.** Wehweck, H. (Muenchen Univ. (Germany, F.R.). Fachbereich Medizin). 5 Nov 1981. 117p. (In German). NTIS (US Sales Only), PC A06/MF A01. File Number DE85780163.

23 biopsies and operation preparations of gynaecological tumours were examined autoradiographically: 8 with an external short-time preirradiation of up to 750 R, one with a curative radiotherapy 1 1/2 years ago. Besides the determination of quantitative parameters of growth kinetics another main concern was to find out the interdependence between the proliferation behaviour of the tumour cells and the histological differentiation of the tumour parenchyma and the topographical location of the malignant cells in the tissue. Possible effects of a previous radiotherapy on the cell proliferation are discussed.

7493 **(INIS-mf—9404) Ministerial Order of 29 September 1983 amending Ministerial Order of 16 July 1980 on the treatment by ionizing radiation of food for human or animal consumption.** (Belgium). 5 Nov 1983. 6p. (In French and Dutch). NTIS (US Sales Only), PC A02/MF A01. File Number DE85780189.

This Order was issued by the Minister of Public Health and the Family and amends the annex to the Order of 16th July 1980 which regulates the treatment by ionizing radiation of food for human and animal consumption. Certain spices and vegetables have now been included for purposes of irradiation; the Order also prescribes the technical specifications to be complied with in their respect.

7494 **(PNL-SA—12715) Plant root absorption and metabolic fate of technetium in plants.** Cataldo, D.A.; Garland, T.R.; Wildung, R.E. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1984. Contract AC06-76RL01830. 22p. (CONF-8410157—5). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003600.

From Scientific seminar on the behavior of technetium in the environment; Cadarache, France (23 Oct 1984).

Root absorption characteristics for the pertechnetate ion ($TcO_4^-$) were determined using hydroponically grown soybean seedlings (Glycine max, cv. Williams). Absorption of $TcO_4^-$ was found to be linear with time, sensitive to metabolic inhibitors, and exhibit multiple absorption isotherms over the concentration range 0.02 to 10 $\mu$M. The isotherms had calculated K/sub s/ values of 0.09, 8.9, and 54 $\mu$M for intact seedlings. The uptake of $TcO_4^-$ (0.25 $\mu$M) was inhibited by a fourfold concentration excess of sulfate, phosphate, and selenate, but not by borate, nitrate, tungstate, perrhenate, iodate or vanadate. Kinetic studies demonstrated that sulfate, phosphate, and selenate were competitive inhibitors of $TcO_4^-$ absorption. Once absorbed, Tc was readily transported as $TcO_4^-$ to shoot tissues of soybean and subsequently associated with protein constituents. The chemical fate of Tc in plants varies with plant species. Plants high in nonprotein sulfhydryl compounds (Allium species) exhibited markedly different root/shoot distribution and protein incorporation patterns from species with low sulfur requirements (soybean, alfalfa, mustard). Based on these differences, Tc/S/Se tracer studies were employed to resolve the comparative fate of these probable analogs. 20 references, 5 figures, 5 tables.

7495 **DNA-mediated cotransfer of excision repair capacity and drug resistance into Chinese hamster ovary mutant cell line UV-135.** MacInnes, M.A.; Bingham, J.M.; Thompson, L.H.; Strniste, G.F. (Los Alamos National Lab., NM). *Molecular and Cellular Biology;* **4**: No. 6, 1152-1158(Jun 1984).

The authors have investigated DNA-mediated transfer of aminopterin resistance conferred by plasmid and UV resistance conferred by genomic DNA to the Chinese hamster ovary (CHO) cell line UV-135, a UV-sensitive mutant defective in nucleotide excision repair. Plasmid pSV2gpt-$CaPO_4$ coprecipitates induced aminopterin resistance with equal efficiency in the 6-thioguanine-resistant, aminopterin-sensitive, repair-proficient parental line AA8-4(tg-1) and in UV-135(tg-2). Genetic and molecular evidence for genomic DNA-mediated transformation of UV-135(tg-2) cells with a putative excision repair gene were obtained. The overall frequency of drug and UV resistance cotransformation was 8 X 10(8) per cell plated. This frequency was ca. 200- to 500-fold greater than that expected from coincident but independent UVr reversion and plasmid gene transfer events. DNA transfer techniques with this CHO system will be useful for further analysis of the essential structural DNA sequences, gene cloning, and expression of functional excision repair genes.

7496 **Physical determinants of radiation sensitivity in bacterial spores.** Powers, E.L. (Texas Univ., Austin). *Advances in Space Research;* **3**: 73-78(1983). (CONF-820582—). Contract AS05-76EV03408.

From 24. COSPAR meeting (Committee on Space Research); Ottawa, Canada (17 May 1982).

Several factors modifying radiation sensitivity in dry bacterial spores are described and discussed. Vacuum inducing the loss of critical structural water, very low dose rates of radiation from which the cell may recover, radiations of high linear energy transfer, and the action of temperature over long periods of time on previously irradiated cells are recognized from extensive laboratory work as important in determining survival of spores exposed to low radiation doses at low temperatures for long periods of time. Some extensions of laboratory work are proposed. 10 references.

7497 **Genetic risks associated with radiation exposures during space flight.** Grahn, D. (Argonne National Lab., IL). *Advances in Space Research;* **3**: 161-170(1983). (CONF-820582—). Contract W-31-109-ENG-38.

From 24. COSPAR meeting (Committee on Space Research); Ottawa, Canada (17 May 1982).

Although the genetic risks of space radiation do not pose a significant hazard to the general population, the risks may be very important to the individual astronaut. The present paper summarizes some experimental results on the induction of dominant lethal mutations and chromosomal damage in the first generation which may be used in the prediction of the genetic risks of radiation exposures of space crews. Young adult male mice were exposed to single, weekly and continuous doses of gamma rays, neutrons in single doses and weekly exposures and continuous doses of Pu-239 alpha particles. Evaluation of fetal survival rates in females mated to the exposed males shows the mutation rate in individuals exposed to gamma rays to decline as the exposure period is prolonged and the dose rate is reduced, while the response to neutrons is in the opposite direction. Cytological determinations show the rate of balanced chromosomal translocations to drop as gamma ray exposures change from one-time to continuous, however little or no dose rate effect is seen with neutron radiation and alpha particle exposure shows no regular dose-response. Based on the above results, it is predicted that the rate of dominant mutations and transmissible

chromosome aberrations in astronauts on a 100-day mission will increase by 4.5 to 41.25 percent over the spontaneous rate. 35 references.

7498 **Cataractogenesis from high-LET radiation and the Casarett model.** Cox, A.B.; Lee, A.C. (Colorado State Univ., Fort Collins). *Advances in Space Research;* **3**: 211-219(1983). (CONF-820582—). Contract W-7405-ENG-48.

From 24. COSPAR meeting (Committee on Space Research); Ottawa, Canada (17 May 1982).

The long-term effects on specific animal tissues of exposure to heavy ion irradiation are studied in experiments on cataractogenesis in mice and rabbits. Five groups of rabbits at ages from 8 weeks to 5.3 years were irradiated to a dose of 9.0 Gy of Bragg plateau Ne-20 ions, while mice were exposed to single and total fractionated doses of 4.17 Gy gamma rays or 0.40 to 1.20 Gy of C-12, Ne-20 or Ar-40 particles. Measurements of lens opacities over time show that in the year since irradiation, cataractogenesis is delayed and less severe in rabbits irradiated at age 6 months compared to younger animals, although it is possible that the late effects in adults will surpass those found in the young. The fractionation of the total dose of gamma rays in mice is observed to lead to a marked reduction in the extent of lens opacity after one year, while fractionated heavy ion doses caused a greater degree of posterior lens opacification. Evaluations of the effects of the LET of different ions on cataractogenesis are consistent with RBEs of about 5, 3 and 1-2 for Ar-40, Ne-20 and C-12 ions, respectively. Results thus support the Casarett model of radiation damaging stem cell populations that are not necessarily part of the vasculature. 41 references.

7499 **SCEs induced by ionizing radiation are not the result of exchanges between homologous chromosomes.** Painter, R.B.; Morgan, W.F. (Univ. of California, San Francisco). *Mutation Research;* **121**: 205-210(1983). Contract AC03-76SF01012.

There is some dispute about the effects of ionizing radiation on the formation of sister-chromatid exchanges (SCEs). To determine if there is a high frequency of simultaneous SCEs in homologs, human lymphocytes were irradiated and the frequency of simultaneous SCEs in homologs of chromosomes 1, 2, and 3 were measured. When cells were irradiated with 150 rad and incubated for two cell cycles in BrdUrd (36), the SCE frequency was not statistically different from the unirradiated controls. When the irradiation followed approximately one BrdUrd labeling cycle and preceded the second cycle of BrdUrd labeling, a significant increase in SCEs was observed. Although the frequency of SCEs was increased 40% after X-irradiation when the treatment occurred between 2 rounds of BrdUrd labeling, there was no evidence for increased frequency of homologous chromosome exchange in X-irradiated cells.

7500 **Movement of eupyrene sperm bundles from the testis and storage in the ductus ejaculatoris duplex of the male pink bollworm: effects of age, strain, irradiation, and light.** LaChance, L.E.; Richard, R.D.; Ruud, R.L. (Dept. of Agriculture, Fargo, ND). *Annals of the Entomological Society of America;* **70**: No. 5, 647-651(Sep 1977).

When pink bollworms, Pectinophora gossypiella (Saunders), were maintained in a 12:12 light-dark regimen, the eurpyrene sperm bundles showed a pronounced rhythm in descending from the testis into the duplex region; they descend from the testis into the upper vas deferens starting at the 3rd or 4th h of the dark period; then with the onset of the light cycle, they descended into the seminal vesicles, accumulated there for the 1st half of the light period, and were transferred to the duplex region of the ejaculatory duct. The same rhythm was maintained in several abdomens. Although laboratory-reared and native strains varied considerably in the number of sperm bundles stored in the duplex, ca. 10-20 entered the duplex each day and accumulated there until the male mated. After mating, the duplex region was emptied of sperm bundles, but mating did not increase the rate or number of sperm bundles that descended to the duplex. Rearing pink bollworm pupae in constant light significantly reduced the number of sperm bundles that were transferred to the duplex. Irradiating newly-emerged males with 30 krad of gamma irradiation had no effect on the number of sperm bundles found in the duplex of 4-day-old males but, in 2 strains studied, 8-day-old males had a reduced number of sperm bundles.

7501 **Inherited $F_1$ sterility in the male pink bollworm: reduction of eupyrene sperm bundles in the testis and duplex.** LaChance, L.E.; Birkenmeyer, D.R.; Ruud, R.L. (Dept. of Agriculture, Fargo, ND). *Annals of the Entomological Society of America;* **72**: No. 3, 343-347(May 1977).

The testis and duplex region of the ejaculatory duct of male Pectinophora gossypiella (Saunders) were examined for differences in the number and morphology of eupyrene and apyrene sperm bundles in sons of irradiated ($F_1$ sons) or untreated (control) males. The testis of $F_1$ and control males contained large numbers of apyrene sperm bundles, and both kinds of males had normal amounts of loose apyrene sperm in the duplex. Similarly, the testes of $F_1$ and control males contained many immature eupyrene sperm bundles. However, in control males, these bundles matured, passed out of the tesis, and were stored as bundles in the duplex. In $F_1$ males, significantly fewer eupyrene bundles matured in the testis and many of the $F_1$ males had no eupyrene sperm bundles in the duplex. Irradiation of $P_1$ males affects spermatogenesis and spermiogenesis in $F_1$ males so that the majority of eupyrene sperm do not descend into the duplex to become available for insemination.

## 5602 Thermal Effects

*REFER ALSO TO CITATION(S) 5602007526, 7527*

7502 **(DOE/ER/10917—2) Effects of freezing and cold acclimation on the plasma membrane of isolated protoplasts. Final report.** Steponkus, P.L. (Cornell Univ., Ithaca, NY (USA). Dept. of Agronomy). 1984. Contract AC02-81ER10917. 15p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85003700.

The objectives were to characterize the stress-strain relationship (SSR) of the plasma membrane of isolated cereal protoplasts to provide a mechanistic basis for the increased tolerance of cold acclimated protoplasts to large area deformations and, as a result, the decreased incidence of expansion-induced lysis during a freeze-thaw cycle. This required the determination of the mechanisms responsible for large area contraction and expansion of the plasma membrane and the formulation of a semi-quantitative theory to explain this behavior; and to determine the incidence of expansion-induced lysis relative to other forms of injury as a function of the freeze-thaw protocol and degree of cold acclimation. The other forms of injury are loss of osmotic responsiveness following cooling, intracellular ice formation, and altered osmometric behavior during warming.

7503 (INIS-mf—9092, pp 130-131) **Effect of heat discharges from thermal and nuclear power stations on water environment.** Adamek, Z. (Vysoka Skola Zemedelska, Brno (Czechoslovakia)). 1983. NTIS (US Sales Only), PC A03/MF A01. File Number TI85780146. (CONF-8005259—; CONF-8209259—; CONF-8109136—).

From ESNA working group meeting on waste heat utilization; Brno, Czechoslovakia (20 May 1980).

With regard to the fact that maximum temperature for preserving the life of most central European fish is given with relative accuracy and that the negative effect of higher temperatures is multiplied by the lower water oxygen content it is necessary to deal with the consequences of the discharge of warm water from thermal and nuclear power plants with regard to ecology. Higher temperatures often result in a quicker development of adaptable organisms and this results in a disturbance of biological equilibrium. It is also stated that while the effect of thermal effluents is studied in closed water bodies such as dam reservoirs and lakes little attention has so far been devoted to the study of biological conditions in small water courses.

7504 **Effects of temperature and salinity on the life cycle of Ophryotroncha diadema (Polychaeta, Dorvilleidae).** Akesson, B. (Univ. of Gothenburg, Sweden). *Ophelia;* **17**: No. 2, 215-229(Nov 1978). Contract AS05-76EV14377.

Ophryotrocha diadema is stenohaline. The complete life cycle has only been observed at salinities of 30, 35 and 40 ‰. At an optimum salinity, 35 ‰, reproduction occurs between 11 and 27°C. Experiments were performed in 5 ‰ steps of salinity from 15 to 45 ‰ combined with temperatures of 11, 18, 21, and 25 °C. At salinities of 15 and 20 ‰ all animals, both adults and larvae, died within two days. In the remaining 20 salinity/temperature combinations adults were kept for 3 weeks and larvae for a minimum of one month or until they were sexually mature. For adults, mortality, number and size of egg masses, and reproductive success were recorded. Corresponding parameters for larvae were mortality, growth rate and time to beginning of reproduction. Optimum conditions for survival were obtained at 35 ‰ salinity and 18°C. The optimum for egg production (reproductive rate) was 35 ‰ and 25°C. The maximum growth rate was observed at 30 and 35 ‰ salinity and 25°C. These two combinations also represented the shortest time of development to sexual maturity. The number of eggs per egg mass was significantly salinity dependent, with an optimum at 35 ‰, but was not affected by temperature, except at 40 ‰ salinity or by salinity/temperature interaction. Both adults and larvae demonstrated good survival at 25 ‰ salinity, but fertilization and/or early development was blocked. This was also true at 45 ‰ where rate of survival was much lower than at 25 ‰. The coefficient of population growth, r, was calculated from the exponential equation N/sub t/ = $N_0$ X e/sup rt/ for the four most favourable salinity/temperature combinations. The highest value was obtained at 25°C and 35 ‰ salinity.

7505 **Adult Mediterranean flour moth: effects of temperature on sperm production and periodicity of testis and vas deferens activity.** Riemann, J.G.; Thorson, B.J. (Dept. of Agriculture, Fargo, ND). *Annals of the Entomological Society of America;* **71**: No. 4, 575-580(Jul 1978).

At constant temperatures of 17°, 22°, 27°, and 32°C, adult Mediterranean flour moths, Anagasta kuehniella (Zeller), released 3.1, 13.3, 22.6, and 12.7 bundles of eupyrene sperm/day from their testes, respectively. Several-fold more apyrene than eupyrene bundles were produced each day. From hourly samplings, sperm started out of the testes of moths held at the 3 highest temperatures at the beginning of the 8th-10th h after the start of the 12-h photophase. Sperm release from moths held at 17°C was usually not detectable until the beginning of the 12th h of the photophase. At both 27°C and 32°C, most sperm passed from the upper vasa deferentia during the 8th-10th h of the scotophase. At lower temperatures, sperm remained in the upper vasa deferentia for increasing periods, and at 17°C the upper vasa deferentia were devoid of sperm for only a few hours. When moths were exposed to alternating temperature cycles (12 h at 11° and 12 h at 27°C), the quantity of sperm produced was the same whether the low temperature occurred during the photophase or the scotophase. When moths were exposed to a warm 12-h day, sperm usually started out of the testes during the 7th h of the photophase; when they were exposed to a cold 12-h day, release usually started during the 3rd h of the scotophase. These patterns were shown to represent entrainment when moths of the 2 groups were transferred to continuous darkness at 27°C. Isolated abdomens showed the same pattern of entrainment as intact moths.

7506 **Effect of salinity and cyclic temperature on larval development of the mud-crab Rhithropanopeus harrisii (Brachyura: xanthidae) reared in the laboratory.** Christiansen, M.E.; Costlow, J.D. Jr. (Univ. of Oslo, Norway). *Marine Biology (Berlin);* **32**: 215-221(1975). Contract AS05-76EV14377.

Larvae of Rhithropanopeus harrisii (Gould) were reared from hatching to the first or second crab stages in 11 combinations of salinities and cyclic temperatures (5, 20, and 35% S at 20° to 25°C, 25° to 30°C, and 30° to 35°C; 25% S at 20° to 25°C and 30° to 35°C). The larvae survived to the megalops and first crab stages in all salinities and cycles of temperature other than 5% S at 30° to 35°C. The best survival to the megalops (94%) and first crab (90%) stages occurred in 20% S, 20° to 25°C. In all other combinations of salinities and temperatures there was a reduction in survival to the first crab stage. The duration of the larval stages was affected significantly by temperature, whereas the effect of salinity on the mean days from hatching to the first crab stage was not consistent at the different temperature cycles. Development to the first crab stage required the shortest time in 20% S, 30° to 35°C (mean 12.3 days), and the longest time in 5% and 35% S, 20° to 25°C (mean 22.6 days and 21.6 days, respectively). Megalops larvae reared in 35% S at all cycles of temperature, as well as larvae in 20% and 25% S, 30° to 35°C, showed a high percentage of abnormality, with the highest percentage occurring in 35% S, 30° to 35°C. It appears that larval development of R. harrisii is strongly influenced by environmental factors and not solely related to genetic differences.

## 5603 Chemicals Metabolism And Toxicity

*REFER ALSO TO CITATION(S) 5603006314, 6746, 6977*

7507 (BNWL—1850-Pt.3, pp 169-170) **Elemental content of trace elements in vegetation collected at Centralia, Washington.** Rancitelli, L.A.; Abel, K.H.; Weimer, W.C. Apr 1974. NTIS.

In Pacific Northwest Laboratory annual report for 1973.

Neutron activation analyses for 28 major, minor, and trace elements in vegetation (pasture grass, tree leaves, moss, and lichens) near a 1400 MW power plant in Centralia, Washington were performed and compared with values for lichen samples collected from a remote region in Alaska. The grasses were selected to reflect recent deposition and uptake, while mosses and lichens were selected for their ability to display long-term effects of pollutants. Concentrations of arsenic, mercury, antimony, and selenium in lichens near the power plant were: 7.2, 0.12, 0.99, and 0.60 micrograms/g, respectively, an order of magnitude higher than Alaskan samples. The concentrations of the other 24 elements did not reflect increased values around Centralia.

7508 **(DOE/MC/08711—T1) Effects of coal combustion and gasification process contaminants on pulmonary carcinogen metabolism.** Colby, H.D. (West Virginia Univ., Morgantown (USA). Medical Center). 9 Jul 1979. Contract AT21-77MC08711. 6p. NTIS, PC A02/MF A01; GPO Dep. File Number DE84017598.

The effects of heavy metals (lead, zinc, cadmium) on benzopyrene metabolism in the lungs of guinea pigs were investigated. Results show that benzopyrene hydroxylation is sensitive to inhibition by heavy metals and is tissue dependent. Heavy metals inhibit pulmonary mixed-function oxidases more than the adrenal or hepatic enzymes. In related studies the effect of metals on pulmonary lipid peroxidation was also investigated. 3 tables. (DMC)

7509 **Metabolism and macromolecular covalent binding of [$^{14}$C]-1-nitropyrene in isolated perfused and ventilated rat lungs.** Bond, J.A.; Mauderly, J.L. (Inhalation Toxicology Research Inst., Albuquerque, NM). *Cancer Research;* **44**: No. 9, 3924-3929(Sep 1984).

The purpose of this study was to quantitate l-nitropyrene (1-NP) metabolism and macromolecular covalent binding in the isolated perfused rat lung. Rat lungs were perfused with 2, 5, or 24 microM [$^{14}$C]-1-NP for 90 min. Tidal volume and dynamic lung compliance were monitored throughout the perfusion to document the ventilatory pattern and the decay of tissue elasticity. Perfusate was sampled periodically throughout the experiment and analyzed for 1-NP metabolites with high-performance liquid chromatography. In all experiments, both dynamic lung compliance and tidal volume declined in a nearly linear manner and were approximately 60% of the initial value at the end of 90 min of perfusion. At all concentrations of [$^{14}$C]-1-NP tested, less than 5 to 6% of the total amount of [$^{14}$C]-1-NP added was metabolized in lungs from control and phenobarbital (PB)-treated rats. Lungs from control and PB- and 3-methylcholanthrene (3-MC)-treated rats metabolized [$^{14}$C]-1-NP to oxidized, reduced, and conjugated metabolites. The major metabolites were 3-, 6-, and 8-hydroxynitropyrene. Treatment of rats with PB resulted in a 60% increase in the total metabolism of [$^{14}$C]-1-NP, whereas treatment of rats with 3-MC resulted in a 10-fold increase in the rate of metabolism of [$^{14}$C]-1-NP when compared to controls. Conjugate hydrolysis studies indicated that the water-soluble metabolites from lungs of control and PB- and 3-MC-treated rats consisted of hydroxynitropyrene glucuronides and hydroxynitropyrene sulfate conjugates. Quantities of $^{14}$C covalently

bound to lung macromolecules after 90 min of perfusion from lungs of control and PB-treated rats were 0.06 to 0.21 nmol equivalents/g lung. However, in lungs from 3-MC-treated rats, there was a 20-fold increase in quantities of 14C covalently bound when compared to lungs from either control or PB-treated rats.

7510 **Effect of short-term ozone exposure on exogenous thyroxine levels in thyroidectomized and hypophysectomized rats.** Clemons, G.K.; Wei, D. (Lawrence Berkeley Lab., CA). *Toxicology and Applied Pharmacology;* **74**: No. 1, 86-90(15 Jun 1984).

Short-term ozone exposure (1 ppm X 24 hr) of male rats results in a significant reduction of circulating thyroid hormones and thyroid stimulating hormone (TSH). The reduction of thyroid hormone levels after ozone exposure has been hypothesized as a possible adaptive mechanism to enhance survival of rats during ozone exposure. In this study, the authors investigated the effect of ozone on thyroid hormone (T4) levels in thyroidectomized and hypophysectomized rats which received exogenous T4 in the drinking water. Groups of normal, intact rats, thyroidectomized rats maintained on T4 at doses ranging from 75 to 1000 micrograms/liter, and hypophysectomized rats maintained on 300 micrograms T4/liter were exposed to ozone (1 ppm X 24 hr), Plasma T4 concentrations were significantly reduced after ozone exposure, and the results indicated that the higher the circulating T4 levels before exposure the more they were reduced after ozone exposure. This reduction in T4 levels cannot be accounted for in these animals by reduced pituitary TSH levels or the effects of fasting, but is likely to be due to peripheral changes in plasma thyroid binding proteins initiated by ozone exposure.

7511 **Comparison of genotoxicity of automotive exhaust particles from laboratory and environmental sources.** Brooks, A.L.; Li, A.P.; Dutcher, J.S.; Clark, C.R.; Rothenberg, S.J.; Kiyoura, R.; Bechtold, W.E.; McClellan, R.O. (Inhalation Toxicology Research Inst., Albuquerque, NM). *Environmental Mutagenesis;* **6**: No. 5, 651-668(1984). Contract AC04-76EV01013.

This research (1) ranked the genotoxicity of methylene chloride extracts of laboratory and environmentally collected particles and (2) evaluated the role of collection location and sample composition on genotoxic potency. Samples of exhaust from a spark-ignition automobile, light-duty diesel automobile, and a heavy-duty diesel engine operated in a laboratory on a dynamometer were studied, as well as samples taken in a highway tunnel and outside the same tunnel. In the Ames Salmonella mutagenicity assay, each extract produced a dose-dependent increase in mutagenicity in strain TA-98 without addition of liver S-9 fraction. The order of mutagenic activity per $\mu$g of extract in TA-98 without S-9 from the lowest to the highest was environmental sample $\leqq$ tunnel $<$ heavy-duty diesel $<$ light-duty diesel $<$ spark ignition. With cell killing, sister chromatid exchanges, and mutations as endpoints in Chinese hamster ovary cells (CHO), the order of potency was tunnel $<$ light-duty $<$ spark-ignition samples. The data indicated that genotoxic activity was detected in each particle extract, that the potency ranking was similar using different genetic endpoints, and that the magnitude of the genotoxic potency was similar.

7512 **Oviposition of Tanytarsus dissimilis (Diptera:Chironomidae) in avoidance trails with coal liquid water-soluble components.** Dauble, D.D.; Skalski, J.R. (Battelle Pacific Northwest Labs., Richland, WA). *Environmental Entomology;* **12**: No. 6, 1733-1736(Dec 1983). Contract AC06-76RL01830.

Oviposition site preference (OSP) of the chironomid Tanytarsus dissimilis (Johannsen) was evaluated in avoidance trials with acutely toxic concentrations of a coal liquid water-soluble fraction (WSF). Tests conducted with groups and with single organisms indicated that ovipositing adults had no significant preference ($\alpha$ = 0.05) for either river water (control) or a coal liquid WSF. Egg strand size was reduced in the coal liquid WSF, suggesting that toxicant detection occurred despite lack of avoidance. The OSP trials conducted with single organisms were advantageous because of lack of independence in group tests and because greater sample size could be obtained with less effort. This type of behavioral study may have an application to hazard evaluation of other toxic substances.

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7513 **Significance of developing energy technologies of coal conversion to plant productivity.** Taylor, G.E. Jr. (Oak Ridge National Lab., TN). *HortScience;* **18**: No. 5, 684-689(Oct 1983). (CONF-8208184—). Contract W-7405-ENG-26.

From Symposium on impact of world atmospheric modification on plant growth and productivity; Ames, IA, USA (11 Aug 1982).

The study of coal conversion emissions to the atmosphere and their influence on crop and forest vegetation focuses on the following: projected changes in regional and local air quality; screening techniques for evaluating an emission's toxicity to vegetation; plant response to major toxic compounds as a function of exposure dose; significance of environmental factors in modifying plant response; and plant uptake of trace organic and inorganic contaminants, as exemplified by polycyclic aromatic hydrocarbons. The spectrum of compounds emitted from coal conversion technologies is diverse; however, most are not likely by themselves to be a threat to vegetation, due to either low emission rates, nonreactivity with foliage, or low inherent chemical toxicity.

7514 **Trace element content of leaves of desert shrubs in south-central Washington.** Rickard, W.H.; Garland, T.R. (Pacific Northwest Lab., Richland, WA). *Northwest Science;* **57**: No. 1, 57-61(1983). Contract AC06-76RL01830.

Analyses of leaves of desert shrubs showed strong differences in macroelements according to species and location on the Arid Lands Ecology (ALE) site in south-central Washington. Halophytes were characterized by high levels of K, Cl, Br, Mn, and Na, and glycophytes by high levels of Ca and Mg. However, trace element content was not significantly different. Big sagebrush (Artemisia tridentata) leaves from Wyoming and the ALE site were not greatly different in trace element content. Natural leaf fall collections can be used to monitor changing levels of trace element content induced by coal combustion steam-electric plants.

7515 **Tissue distribution of cadmium and metallothionein as a function of time of day and dosage.** Cahill, A.L.; Nyberg, D.; Ehret, C.F. (Argonne National Lab., IL). *Environmental Research;* **31**: 54-65(1983). Contract W-31-109-ENG-38.

Cadmium-109 chloride (1 mg or 48 ng $Cd^{2+}$/kg body wt) was administered intraperitoneally to rats at one of eight selected times of day. Exactly 48 hr later each animal was sacrificed, and the cadmium content of the blood, brain, heart, kidney, liver, and testes was determined. Metallothionein levels in the liver and kidney were also measured. Distribution and retention of cadmium was very different at the different dose levels. Approximately 60% of the higher dose could be accounted for in these six tissues. The liver retained the largest percentage of the administered cadmium at both dose levels, but the magnitude of the retention differed by a factor of 6 (57.3% of the higher dose and 9.6% of the lower dose). The pattern of cadmium distribution among the other tissues was also different. At the 1-mg $Cd^{2+}$/kg body wt level, the kidneys accumulated the second largest fraction of cadmium, followed by the blood, heart, testes, and brain. In the 48-ng $Cd^{2+}$/kg body wt groups the order was kidney, testes, blood, heart, and brain. Only in the testes of animals receiving the low dose of cadmium was there an effect of time of day, and here the effect was marked. When cadmium was administered during the dark phase of the daily cycle, the testes contained an average of six times more cadmium than when cadmium was given during the light phase. Similarly, levels of metallothionein in the kidney were significantly higher when cadmium was administered during the dark phase. A trend toward higher metallothionein levels in the liver during the dark phase was also observed, but this trend was not statistically significant.

7516 **Pathologic effects in rodents exposed to sodium combustion products.** Busch, R.H.; McDonald, K.E.; Briant, J.K.; Morris, J.E.; Graham, T.M. (Pacific Northwest Lab., Richland, WA). *Environmental Research;* **31**: 138-147(1983). Contract AC06-76RL01830.

Three species of rodents exhibited respiratory distress when exposed to aerosols of sodium combustion products, the major con-

stituent of which was shown to be sodium carbonate. At the higher doses, animals died during or shortly after 2 hr exposures. Lesions, primarily involving the pharynx and larynx, included accumulation of mucus, vesiculation, and mucosal edema. Other lesions included edema and vesiculation of the anterior trachea, hemorrhage in the lungs, and severe gastric tympany. Basal epithelial cells of the posterior pharynx and anterior trachea had enlarged mitochondria following exposures of 1 hr or more.

7517 **Quantifying effects of oxidant air pollutants on agricultural crops.** Medeiros, W.H.; Moskowitz, P.D. (Brookhaven National Lab., Upton, NY). *Environment International;* **9**: No. 6, 505-513(1983).

Estimating risks of air pollution damage to agricultural crops requires identifying crop location and size, likely doses, models for translating dose to response, and measures of response appropriate for economic analysis. Assessment of risk requires compatible data sets for each of these variables. Analysis of air pollution mixtures suggests that oxidant crop damage is caused by three compounds: ozone, nitrogen oxides, and peroxyacetylnitrates. The phytotoxicity of ozone, the most prevalent photochemical oxidant, has been studied more extensively than the other two oxidants, and its effects on vegetation are best understood. Response of vegetation to air pollutants was first characterized by foliar or visible injury. Subsequent research indicated that foliar injury did not translate directly into reduced plant growth or yield, which can be measured. Response to air pollutants may be influenced by physical, biological, and environmental factors. Inherent genetic resistance is probably the most important single factor affecting plant response, although environmental factors influencing stomatal aperture may also be important. For several crops open-top chamber studies and cross sectional analyses of field data provide adequate information to develop dose-response functions. All of these studies have both strengths and weaknesses. Although a number of different models exist for selected crops, there is no single biological or statistical criterion which identifies the best or most accurate model.

7518 **Health effects of oxidants.** Rowe, M.D.; Novak, K.M.; Moskowitz, P.D. (Brookhaven National Lab., Upton, NY). *Environment International;* **9**: No. 6, 515-528(1983).

Oxidants of significance to human health include ozone, nitrogen dioxide, and peroxyacetylnitrate. All of these compounds are involved in complex photochemical reactions which makes quantification and prediction of their individual health effects difficult. Ozone causes trauma to lung tissues and interfaces with enzyme systems in the lungs and other tissues causing a broad range of symptoms. Measurable health impacts can occur at concentrations as low as 390 $\mu g/m^3$. Acute effects of ozone exposure are reversible at normal urban concentration (80-120 $\mu g/m^3$). A special problem of concern, however, is increased susceptibility to infectious diseases contracted through the lungs. Nitrogen dioxide also causes trauma to lung tissues and interferes with enzyme systems. Measurable impacts can occur at concentrations as low as 100 $\mu g/m^3$, but recovery is rapid and it is not known whether repeated exposures at this level have cumulative effects or predispose the lungs to permanent damage. Chronic exposure of laboratory animals to higher nitrogen dioxide levels can cause emphysema-like conditions and reduction in resistance to respiratory infection. Epidemiological studies of children in houses with gas stoves confirm the finding of reduced resistance to respiratory infection. The US EPA estimates that health effects may occur in young children exposed to concentrations in excess of 280 to 560 $\mu g/m^3$ one-hour average. These concentrations occur routinely in houses having gas stoves. Peroxyacetylnitrate is a powerful eye irritant in photochemical smog. Other health effects are similar to those of ozone, but less important because of the relatively low concentrations of this pollutant compared to other oxidants.

7519 **Root absorption and transport behavior of technetium in soybean.** Cataldo, D.A.; Wildung, R.E.; Garland, T.R. (Battelle Pacific Northwest Lab., Richland, WA). *Plant Physiology;* **73**: 849-852(1983). Contract AC06-76RL01830.

The absorption characteristics and mechanisms of pertechnetate ($TcO_4^-$) uptake by hydroponically grown soybean seedlings (Glycine max cv Williams) were determined. Absorption from 10 micromolar solutions was linear for at least 6 hours, with 30% of the absorbed $TcO_4^-$ being transferred to the shoot. Evaluation of concentration-dependent adsorption rates from solutions containing 0.02 to 10 micromolar $TcO_4^-$ shows the presence of multiphasic absorption isotherms with calculated K/sub s/ values of 0.09, 8.9, and 54 micromolar for intact seedlings. The uptake of $TcO_4^-$ was inhibited by a 4-fold concentration excess of sulfate, phosphate, selenate, molybdate, and permanganate; no reduction was noted with borate, nitrate, tungstate, perrhenate, iodate, or vanadate. Analyses of kinetics of interaction $TcO_4^-$ and inhibiting anions show permanganate to be a noncompetitive inhibitor, while sulfate, phosphate, and selenate, and molybdate exhibit characteristics of competitive inhibitors of $TcO_4^-$ transport suggesting involvement of a common transport process.

7520 **Effects of negatively charged aerosol on blood and cerebrospinal fluid parameters in rats.** Wehner, A.P.; Ragan, H.A.; Jaffe, R.A.; Weigel, R.J.; Lundstrom, D.L. (Pacific Northwest Lab., Richland, WA). *International Journal of Biometeorology;* **27**: No. 3, 259-269(1983).

Adult male rats were exposed for 90 to 140 minutes to negatively charged tapwater aerosol. Blood and cerebrospinal fluid samples were collected to determine effects of the exposure on selected hematologic and serum chemistry parameters, and ionized calcium and pH in cerebrospinal fluid. Of the 27 variables assayed 24 yielded sufficient data for statistical analysis. Two parameters, serum alkaline phosphatase and mean corpuscular hemoglobin concentration, were significantly different ($p<0.05$) from control values, probably representing chance occurrences. It appears that whatever biological effects may be exerted by electro-aerosols, they are not mediated by the parameters investigated in this study.

7521 **Induction of sister chromatid exchanges and inhibition of cellular proliferation in vitro. I. Caffeine.** Guglielmi, G.E.; Vogt, T.F.; Tice, R.R. (Univ. of Pennsylvania, Philadelphia). *Environmental Mutagenesis;* **4**: 191-200(1982).

While many agents have been examined for their ability to induce SCE's, complete dose-response information has often been lacking. We have reexamined the ability of one such compound - caffeine - to induce SCEs and also to inhibit cellular proliferation in human peripheral lymphocytes in vitro. An acute exposure to caffeine prior to the DNA synthetic period did not affect either SCE frequency or the rate of cellular proliferation. Chronic exposure to caffeine throughout the culture period lead to both a dose-dependent increase in SCEs (SCE/sub d/ or doubling dose = 2.4 mM; $SCE_{10}$ or the dose capable of inducing 10 SCE = 1.4 mM) and a dose-dependent inhibition of cellular proliferation ($IC_{50}$ or the 50% inhibition concentration = 2.6 mM). The relative proportion of first generation metaphase cells, an assessment of proliferative inhibiton, increased linearly with increasing caffeine concentrations. However, SCE frequency increased nonlinearly over the same range of caffeine concentrations. Examination of the ratio of nonsymmetrical to symmetrical SCEs in third generation metaphase cells indicated that caffeine induced SCEs in equal frequency in each of three successive generations. The dependency of SCE induction and cellular proliferative inhibition on caffeine's presence during the DNA synthetic period suggests that caffeine may act as an antimetabolite in normal human cells.

7522 **Acute cytotoxicity of fossil-energy-related comparative research materials.** Schultz, T.W. (Oak Ridge National Lab., TN). *Journal of Environmental Science and Health, Part A: Environmental Science and Engineering;* **A17**: No. 2, 153-167(1982). Contract W-7405-ENG-26.

Aqueous extracts of five fossil-energy-related comparative research materials have been examined under acute static conditions for toxic effects by use of the Tetrahumena assay system. Cells were exposed to various concentrations of extracts, and cytolysis and population growth impairment were monitored. In addition, chemical class fractionation and major organic elemental analysis were performed. Synthetic fossil fuel materials are more toxic than conventional petroleum crude oils and coal-derived materials are more toxic than crude shale oil. Synthetic fossil-fuel-related materials have a higher nitrogen and oxygen content and a greater aromaticity than do natural crude oils. Acute toxicity appears to be corre-

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lated with ether-soluble acid (phenolic) content, mono- and diaromatic hydrocarbon content, and ether-soluble base (primary aromatic amines and azaarenes) content.

7523 **Cytotoxicity and mutagenicity of dimethylnitrosamine in mammalian cells (CHO/HGPRT system): enhancement by calcium phosphate.** O'Neill, J.P.; Machanoff, R.; Sebastian, J.R.S.; Hsie, A.W. (Oak Ridge National Lab., TN). *Environmental Mutagenesis;* **4**: 7-18(1982). Contract W-7405-ENG-26.

The cytotoxicity and mutagenicity of dimethylnitrosamine (DMN) was determined in the CHO/HGPRT system. Metabolic activation of the promutagen was achieved by use of a liver homogenate supernatant (S9) prepared from Aroclor 1254-induced Sprague-Dawley rats. The cytotoxic and mutagenic effects of DMN were enhanced by the inclusion of calcium chloride in the incubation mix, and this enhancement was dependent on the presence of sodium phosphate. Under conditions that yielded maximal activity (10 mM calcium chloride, 10 mM magnesium chloride, 50 mM sodium phosphate), an apparent calcium phosphate precipitate was observed. DMN activity increased with increasing amounts of S9 protein over the range 0.3-3.0 mg/ml in the S9 mix and appeared to plateau at higher concentrations. The mutagencity of DMN can be described as 110 mutants/$10^8$ cells per mM DMN per mg/ml S9 protein per hour.

7524 **Gastrointestinal absorption of lead ($^{203}$Pb) in chicks: influence of lead, calcium, and age.** Mykkaenen, H.M.; Wasserman, R.H. (Cornell Univ., Ithaca, NY). *Journal of Nutrition;* **111**: No. 10, 1757-1765(Oct 1981). Contract AC02-76EV02792.

The present study was designed to investigate, in more detail, the mechanism of lead transport by the gastrointestinal tract and particularly the similarities or dissimilarities between lead and calcium in this process. The absorption of these metals was determined in 3-week-old white Leghorn cockerels, raised on a commercial diet or special diets, using an in vivo ligated loop procedure. The dose administered into the loop usually contained 0.5 $\mu$Ci $^{203}$Pb (and/or 0.1 $\mu$Ci $^{47}$Ca), 0.01 mM lead acetate (and/or 1 mM $CaCl_2$) in 0.5 ml of 0.15 M NaCl, pH 6.5. It was shown that lead is rapidly taken up by the intestinal tissue, and only slowly transferred into the circulation whereas calcium, also accumulated rapidly by the tissue, is rapidly released from the tissue in the serosal direction. The absorption processes of these cations show similar responses to various experimental conditions (low calcium intake, age of the animal, pH of the dosing solution). However, increasing luminal stable lead concentration from 0.01 to 1 mM Pb, significantly reduced the percentage of radio-lead absorbed, but did not inhibit the absorption of $^{203}$Pb. These data imply that, in spite of the similarities in the response of the lead and calcium absorptive processes to various treatments, there is no direct interaction between these cations in the intestine of the chick.

7525 **Evaluation of tests using DNA repair-deficient bacteria for predicting genotoxicity and carcinogenicity.** Leifer, Z.; Kada, T.; Mandel, M.; Zeiger, E.; Stafford, R.; Rosenkranz, H.S. (New York Medical Coll., Valhalla). *Mutation Research;* **87**: 211-297(1981). Contract W-7405-ENG-26.

The detection of DNA-damaging agents by repair-deficient bacterial assays is based on the differential inhibition of growth of repair-proficient and repair-deficient bacterial pairs. The various methodologies used are described and recommendations are made for their improved use. In a survey of the literature through April 1979, 91 of 276 papers evaluated contained usable data, resulting in an analysis of 611 compounds that had been assayed in 1 or more of 55 pairs of repair-proficient and repair-deficient strains. The results indicate that a liquid suspension assay is more sensitive than a spot (diffusion) test. There was a 78% correspondence between results obtained with E. coli polA and Bacillus subtilis (H17/M45, 17A/45T) rec assay and between E. coli polA and Proteus mirabilis. In a comparison of test results with carcinogenicity data, 44 of 71 (62%) carcinogenic compounds assayed by the polA system were positive, 10 (14%) were negative, and 17 (24%) gave No Test or doubtful results. The results were analyzed with respect to chemical classes. E. coli polA detected the highest percentage of hydroxylamines and alkyl epoxides. The B. subtilis rec assay detected the highest percentage of nitrosamines and sulfur and nitrogen oxides. It is concluded that some of these test systems are effective tools for the detection of DNA-damaging and potentially carcinogenic compounds, especially if the assay is done in liquid suspension and if more than 1 pair of tester strains is used. Advantages and disadvantages of the assay are discussed and suggestions are made for improvements in the system.

7526 **Effects of the juvenile hormone mimic Zr-515 (Altosid) on larval development of the mud-crab Rhithropanopeus harrisii in various salinities and cyclic temperatures.** Christiansen, M.E.; Costlow, J.D. Jr.; Monroe, R.J. (Univ. of Oslo, Norway). *Marine Biology (Berlin);* **39**: 269-279(1977). Contract AS05-76EV14377.

Effects of 0.01, 0.1, and 1.0 ppm methoprene (Altosid: ZR-515), a juvenile hormone (JH) mimic were tested on larvae of the mud-crab Rhithropanopeus harrisii (Gould) (Brachyura: Xanthidae) from hatching to the first crab stage under optimum and stress conditions of a number of salinities and cyclic temperatures. There was a significant reduction in survival of zoeal larvae with increasing concentrations of methoprene in nearly all combinations of salinity and temperature. On the average there was 9% less survival in the 0.01 ppm concentration of methoprene than in the control, and in the 0.1 ppm concentration the survival was further reduced by another 16%. At 1.0 ppm methoprene no larvae survived beyond the first zoeal stage under optimum conditions or under stressful combinations of salinity and temperature. Except at 0.1 ppm in 27.5% S, survival of the megalopa was not significantly reduced in 0.01 or 0.1 ppm methoprene in any salinity or temperature, although the percentage of abnormal megalopa increased under stress conditions. The first zoeal stage was the most sensitive of the larval stages to methoprene as well as to salinity and temperature stress. The duration of zoeal development was significantly lengthened with an increase in concentration of methoprene under nearly all conditions of salinity and temperature. The JH mimic had, however, no significant effect on the duration of megalopa development. It can be concluded from the results that methoprene does not inhibit metamorphosis of R. harrisii larvae at the 0.1 ppm level or lower. Reduction in survival of zoeal stages and increased duration of zoeal development with increasing concentrations of methoprene are presumably related to stress.

7527 **Synergistic effects of cadmium and salinity combined with constant and cycling temperatures on the larval development of two estuarine crab species.** Rosenberg, R.; Costlow, J.D. Jr. (Duke Univ., Beaufort, NC). *Marine Biology (Berlin);* **38**: 291-303(1976).

The developmental stages from megalopa to third crab of the blue crab Callinectes sapidus Rathbun were tested in 12 combinations of cadmium (0, 50 and 150 ppb) and salinity (10, 20, 30, and 40%) at 25°C. A reduction in survival and a significant delay in development from megalopa to third crab occurred within each salinity regime in 50 ppb compared with the control. Comparison of the delay in development within each salinity regime revealed that the sublethal effect of cadmium was most pronounced in the salinities normally preferred by C. sapidus. A similar comparison within each cadmium concentration, however, showed that the developmental time from megalopa to third crab was approximately the same irrespective of salinity. The developmental stages from hatch to first crab of the mud-crab Rhithropanopeus harrisii (Gould) were examined in 63 combinations of cadmium (0, 50, and 150 ppb), salinity (10, 20, and 30%), constant temperature (20°, 25°, 30°, and 35°C) and cycling temperature (20° to 25°, 25° to 30°, and 30° to 35°C). The results indicated that cycling temperatures may have a stimulating effect on survival of the larvae compared to constant temperatures, both in the presence and in the absence of cadmium. Effects of cadmium and salinity and their interaction on the survival of the larvae from zoeae to megalopa were documented at most of the temperatures by analyses of variance. The zoeal larvae were more susceptible to cadmium than the megalopa. Effects of different combinations of cadmium and salinity on the duration of larval development were assessed by a t-test.

7528 **Biotransformation of organo-mercurials in mammals.** Clarkson, T.W. pp 229-238 of Environmental mercury contamination. Hartung, R.; Dimman, B.D. (eds.). Ann Arbor, MI, USA; Ann Arbor Science Publishers (1972).

The role of biotransformation in mercury distribution deposition and in the excretion of mercury by mammals is reviewed. Data on mercury deposition in kidney and liver tissues is discussed.

## 5604 Other Environmental Pollutant Effects

7529 **(NP—5770090) Estimation of the economic and technical consequences of a further reduction in the permitted noise level of vehicles (cars and lorries).** (Verband der Automobilindustrie e.V., Frankfurt am Main (Germany, F.R.)). Jul 1980. 30p. (In German). NTIS (US Sales Only), PC A03/MF A01. File Number DE85770090.

The EEC commission proposed to reduce the permitted noise level of cars to 75 dB(A) and of lorries to 80 dB(A) by 1985. This is a report on an investigation relating to this for both groups of vehicles and its results. The well-known solutions to this problem (estimated effect, costs, technical and economic disadvantages) were compiled in a table and the loading by direct and indirect costs was discussed. Technical problems which could not be solved and difficulties in lowering the noise level of Diesel engines and cross-country vehicles are explained. The possibility of reducing the noise by integral and tunnel lining in commercial vehicles is considered and so are the permissible noise level of the cooling system, the exhaust and the drive axles. The estimates are made on the assumption that the test process ISO-R-362 will continue to be used (this does not give typical values for town traffic). Summarising, it was found that an effective reduction in noise can only be achieved by applying all possible measures, such as road planning, traffic control, noise shielding, driving behaviour and emission of noise from vehicles and not just by regulations affecting the vehicle.

7530 **The absence of significant short-term electromagnetic bioeffects in giant algal cells exposed to CW and pulse-modulated X-band bursts.** Gokhale, A.V.; Montaigne, K.; Pickard, W.F. (Department of Electrical Engineering, Washington University, Saint Louis, MO 63130). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Microwave Theory and Techniques;* **MTT-32**: No. 8, 795-798(Aug 1984).

Giant cells of the algae Chara brauni and Nitella flexilis were exposed to continuous wave and pulse-modulated bursts of X-band microwaves and the vacuolar potential was monitored for immediate radiation-correlated offsets. No such offsets were observed despite a resolution of approximately 5 in $10^5$, and despite the wide variety of frequencies, power levels, and pulse protocols employed.

7531 **Interaction of the near-zone fields of a slot on a conducting sphere with a spherical model of man.** Zhu, S.; Chen, K.; Chuang, H. (Department of Electrical Engineering and System Science, Michigan State University, East Lansing, MI 48824). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Microwave Theory and Techniques;* **MTT-32**: No. 8, 784-795(Aug 1984).

The authors consider the geometry of a lossy dielectric sphere, simulating a human body, placed in the proximity of a conducting sphere with a radiating slot, simulating a leaking microwave oven. An exact solution is obtained for this idealized problem by using two spherical coordinate systems and employing the addition theorem to translate the vector spherical harmonics between the coordinate systems. Multiple scatterings of the EM wave between the two spheres are determined by solving the boundary value problems iteratively. An extensive numerical computation has been conducted to determine the induced SAR in the dielectric sphere, and the body-source coupling effect was evaluated. It was found that a serious error in the SAR estimation can be caused if the body-source coupling is neglected, a common approximation used in most of the existing studies on the subject.

7532 **Microwave-induced post-exposure hyperthermia: Involvement of endogenous opioids and serotonin.** Lai, H.; Chou, C.K.; Guy, A.W.; Horita, A. (Departments of Pharmacology, Psychiatry, and Behavioral Sciences, and the Center for Bioengineering, University of Washington School of Medicine, Seattle, WA 98195). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Microwave Theory and Techniques;* **MTT-32**: No. 8, 882-887(Aug 1984).

Acute exposure to pulsed microwaves (2450 MHz, 1 mW/$cm^2$, SAR 0.6 W/kg, 2-μs pulses, 500 pulses/s) induces a transient post-exposure hyperthermia in the rat. The hyperthermia was attenuated by treatment with either the narcotic antagonist naltrexone or one of the serotonin antagonists cinanserin, cyproheptadine, or metergoline. It was not affected, however, by treatment with the peripheral serotonin antagonist xylamidine nor the dopamine antagonist haloperidol. It thus appears that both endogenous opioids and central serotonin are involved. It is proposed that pulsed microwaves activate endogenous opioid systems, and that they in turn activate a serotonergic mechanism that induces the rise in body temperature.

7533 **Microwave-induced thermoacoustic effect in dielectrics and its coupling to external medium-A thermodynamical formulation.** Guo, T.C.; Guo, W.W.; Larsen, L.E. (Johns Hopkins Applied Physics Laboratory, Laurel, MD 20707). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Microwave Theory and Techniques;* **MTT-32**: No. 8, 835-843(Aug 1984).

A thorough formulation of electromagnetic wave interaction with biological systems is presented. The thermodynamic process of the microwave-induced thermoacoustic generation is clearly defined. Couplings of the acoustic and thermal energies to the surrounding medium are included through consideration of discontinuities of thermodynamical variables and microwave exposure. Contrary to prior analyses, it is shown that acoustic waves may be generated by pulsed microwaves, even in the absence of inhomogeneity of microwave absorption, owing to discontinuities of thermodynamical variables and microwave exposure conditions across the interface. General equations for the thermoacoustic waves are derived, and the validity of the first-order linear approximation is estimated in terms of its percentage error. For a system with water as the absorbing dielectric interfacing with air of 1 atmosphere pressure, the first-order approximation becomes invalid for a peak specific absorption rate greater than 13 kW/gm.

7534 **Relationship between field strength and arousal response in mice exposed to 60-Hz electric fields.** Rosenberg, R.S.; Duffy, P.H.; Sacher, G.A.; Ehret, C.F. (Argonne National Lab., IL). *Bioelectromagnetics (New York);* **4**: 181-191(1983). Contract W-31-109-ENG-38.

White-footed mice, Peromyscus leucopus, were exposed to 60-Hz electric fields to study the relationship between field strength and three measures of the transient arousal response previously reported to occur with exposures at 100 kV/m. Five groups of 12 mice each were given a series of four 1-h exposures, separated by an hour, with each group exposed at one of the following field strengths: 75, 50, 35, 25, and 10 kV/m; 8 additional mice were sham-exposed with no voltage applied to the field generator. All mice were experimentally naive before the start of the experiment, and all exposures occurred during the inactive (lights-on) phase of the circadian cycle. The first exposure produced immediate increases in arousal measures, but subsequent exposures had no significant effect on any measure. These arousal responses were defined by significant increases of gross motor activity, carbon dioxide production, and oxygen consumption, and were frequently recorded with field strengths of 50 kV/m or higher. Significant arousal responses rarely occurred with exposures at lower field strengths. Responses of mice exposed at 75 and 50 kV/m were similar to previously described transient arousal responses in mice exposed to 100-kV/m electric fields. Less than half of the mice in each of the field strength groups below 50 kV/m showed arousal response based on Z (standard) scores, but the arousals of the mice that did respond were similar to those of mice exposed at higher field strengths. Polynomial regression was used to calculate the field strength produc-

ing the greatest increases for each of the arousal measures. The results show that the amplitude of the transient arousal response is related to the strength of the electric field, but different measures of arousal may have different relationships to field strength.

# 57 HEALTH AND SAFETY

**7535 (DOE/EP/15100—T13) Special studies and analyses for the Assistant Secretary for Policy, Safety, and Environment. Final report.** (Aerospace Corp., Washington, DC (USA)). Nov 1984. Contract AC01-82EP15100. 83p. NTIS, PC A05/MF A01; GPO Dep. File Number DE85003687.

The report identifies major tasks accomplished, details plans for the orderly completion of all work in process, and provides a complete listing of deliverables (reports, briefings, letters, etc.) provided under the contract. Purpose of this contract was to provide environmental studies, analytical planning, evaluation, and other technical assistance and support to the DOE Office of the Assistant Secretary for Environmental Protection, Safety and Emergency Preparedness (EP) and designated EP offices and divisions.

**7536 (EGG-M—16684) Heat stress and personal protective equipment.** Huntsman, B.W. (EG and G Idaho, Inc., Idaho Falls (USA)). Aug 1984. Contract AC07-76ID01570. 28p. (CONF-840963—5). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85003552.

From DOE and DOE contractors' occupational safety and health conference; San Diego, CA, USA (11 Sep 1984).

The use of personal protective equipment (PPE) in the radiological environment often restricts the body's natural ability to dissipate heat. This paper discusses: (1) the basic physiology of heat stress and strain; (2) the use of PPE in accentuating heat stress; and (3) the proposed Heat Stress Program at EG and G Idaho, Inc. 18 references, 2 figures, 6 tables. (ACR)

**7537 (EGG-M—17384) Counseling the accident driver.** (EG and G Idaho, Inc., Idaho Falls (USA)). 1984. Contract AC07-76ID01570. 9p. (CONF-8410163—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003554.

From National safety congress; Chicago, IL, USA (15 Oct 1984).

Recommendations based on the operating experience of EG & G Idaho in the handling and rehabilitation of problem employees are presented. (ACR)

**7538 (EGG-M—18184) Computerized Accident/Incident Reporting System (CAIRS) update.** Fielding, J.R. (EG and G Idaho, Inc., Idaho Falls (USA)). 1984. Contract AC07-76ID01570. 6p. (CONF-840963—7). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003407.

From DOE and DOE contractors' occupational safety and health conference; San Diego, CA, USA (11 Sep 1984).

The Department of Energy's Safety Performance Measurement System (SPMS) is a user oriented, computerized DOE-wide network which centrally collects and disseminates information related to Environment, Safety and Health performance. The Computerized Accident/Incident Reporting System (CAIRS) is the first module of the SPMS to be implemented. The CAIRS is a computerized data base that includes all personnel injuries, vehicle accidents, and property damage cases in the DOE system from January 1, 1981 to present. This report presents an overview of progress in implementing this data base. (ACR)

**7539 (INIS-mf—9410) Regulations of 8 April 1983 on Sunlamps.** (Norway). 8 Apr 1983. 5p. (In Norwegian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85780185.

These regulations deal with the technical aspects of the construction and use of sunlamps. They provide in particular that sunlamps must be approved by the National Institute of Radiation Hygiene prior to their sale or use.

**7540 (MLM—3217(OP)) Application of 5700.6B, Quality Assurance, to ES & H programs: Mound's approach and results.** Edling, D.A. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 1984. Contract AC04-76DP00053. 14p. (CONF-841187—14). NTIS, PC A02. File Number DE85003304.

From 5. DOE environmental protection information meeting; Albuquerque, NM, USA (6 Nov 1984).

Quality Assurance has always been integral to Mound's production and support operations. Weapons material and other designated material for WR programs are processed and controlled per the requirements of DOE/AL Quality Control Policy QC-1. Mound's non-WR activities, such as siting, design, construction, testing, operation, maintenance, development, and production of materials, components, and systems, and acquisition of research and technology data, are to be processed and controlled per the requirements of AL Order 5700.6. This paper presents an overview of the entire Quality Assurance Program at Mound and specifically addresses Mound's formal application of Quality Assurance to our comprehensive Environmental, Safety and Health (ES & H) Programs. 4 figures, 1 table.

**7541 (PNL-SA—12535) Safety, how much is enough - a study of residual risk.** Piatt, J.A. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1984. Contract AC06-76RL01830. 7p. (CONF-840963—8). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003641.

From DOE and DOE contractors' occupational safety and health conference; San Diego, CA, USA (11 Sep 1984).

The concept of residual risk as a tool for determining how much safety is enough was examined. Residual risk is defined as an expression of loss potential in terms of both loss severity and loss probability for a given system. 3 references. (ACR)

**7542 (UCAR—10129) Lawrence Livermore National Laboratory earthquake safety program.** Freeland, G.E. (Lawrence Livermore National Lab., CA (USA)). 21 Aug 1984. Contract W-7405-ENG-48. 42p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85004454.

Within three minutes on the morning of January 24, 1980, an earthquake and three aftershocks, with Richter magnitudes of 5.8, 5.1, 4.0, and 4.2, respectively, struck the Livermore Valley. Two days later, a Richter magnitude 5.4 earthquake occurred, which had its epicenter about 4 miles northwest of the Lawrence Livermore National Laboratory (LLNL). Although no one at the Laboratory was seriously injured, these earthquakes caused considerable damage and disruption. Masonry and concrete structures cracked and broke, trailers shifted and fell off their pedestals, office ceilings and overhead lighting fell, and bookcases overturned. We suddenly found ourselves immersed in a site-wide program of repairing earthquake-damaged facilities, and protecting our many employees and the surrounding community from future earthquakes. Over the past four years, LLNL has spent approximately $10 million on its earthquake restoration effort for repairs and upgrades. The discussion in this paper centers upon the earthquake damage that occurred, our clean-up and restoration efforts, the seismic review of LLNL facilities, our site-specific seismic design criteria, computer-floor upgrades, ceiling-system upgrades, unique building seismic upgrades, geologic and seismologic studies, and seismic instrumentation. 9 references, 37 figures, 2 tables.

# 58 GEOSCIENCES

## 5801 Geology And Hydrology

*REFER ALSO TO CITATION(S) 5801006468, 6488, 6502, 6506, 6518*

**7543 (DOE/EV/70029—T1) Mesoscale studies of flow regimes and fluxes of particulate matter in coastal waters. Final report, 1 April 1977-31 January 1983.** Nelson, D.M.; Pak, H.; Small, L.F.; Zaneveld, J.R.V. (Oregon State Univ., Corvallis (USA). Dept. of Oceanography). Dec 1984. Contract AT06-77EV70029. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003825.

Research results in the following areas are summarized: (1) the historical (10 year) patterns of phytoplankton biomass and productivity off central Oregon have been described; (2) an in situ instrument package has been developed; (3) a new method of measuring the relative abundance of biogenic particles and terrigenous particles has been tested; (4) the winter distributions and movements of suspended particulate matter in a near-coast region of smooth bathymetry have been observed; (5) the summer distribution and movements of suspended particulate matter in the region of a submarine canyon have been observed; (6) the biological and chemical nature of the suspended particulate matter has been characterized; (7) the processes forming and maintaining the prominent subsurface oxygen maximum have been elucidated; (8) an attenuation meter capable of being moored for several months has been developed and deployed; and (9) a monthly sampling program to determine the seasonal cycle of suspended particulate matter distribution and composition was conducted. 4 references, 9 figures, 1 table. (ACR)

7544 **(INIS-mf—9087) Annual report 1982 of ZWO Laboratory of Isotope Geology.** (Laboratorium voor Isotopen-Geologie, Amsterdam (Netherlands)). Jul 1983. 21p. (In Dutch). NTIS (US Sales Only), PC A02/MF A01. File Number DE85780133.

This report gives a brief account of the activities of the ZWO Laboratory of Isotope Geology during 1982. The main point of interest is the research for new possible applications of gas-mass spectrometry in geology. Kr and Xe turn out to be produced at the spontaneous fission of $^{238}U$ present in zirconium crystals. Mass-spectrometric isotope analysis has been carried out, resulting in a tentative age estimation.

7545 **(INIS-mf—9117) $^{85}Kr$ in ground water - methods of measurement, model assumptions, application to natural ground water systems.** Salvamoser, J. (Muenchen Univ. (Germany, F.R.). Fakultaet fuer Physik). 6 Dec 1982. 130p. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number DE85780136.

The representation in the field of the gases dissolved in the water is performed by means of a vacuum extraction technique. A special low level measuring point serves for detecting the low Kr 85 activity. A comparison of the output values of the T- and 85 Kr concentrations shows, for models, that the mean retention times obtained by calculation from the Kr 85-concentrations are largely independent by models up to a range of 7 years. For application of the model calculations to natural waters the Kr-85, t- and C-14 contents of surface and ground waters have been measured in the three hydrologically well-known test region of the upper Loisach valley, southern Frankenalb and Sallern.

7546 **(ORNL/TM—8983) Integrated compartmental model for describing the transport of solute in a fractured porous medium.** DeAngelis, D.L.; Yeh, G.T.; Huff, D.D. (Oak Ridge National Lab., TN (USA)). Oct 1984. Contract AC05-84OR21400. 141p. NTIS, PC E06/MF A01; 1; GPO Dep. File Number DE85003546.

This report documents a model, FRACPORT, that simulates the transport of a solute through a fractured porous matrix. The model should be useful in analyzing the possible transport of radionuclides from shallow-land burial sites in humid environments. The use of the model is restricted to transport through saturated zones. The report first discusses the general modeling approach used, which is based on the Integrated Compartmental Method. The basic equations of solute transport are then presented. The model, which assumes a known water velocity field, solves these equations on two different time scales; one related to rapid transport of solute along fractures and the other related to slower transport through the porous matrix. FRACPORT is validated by application to a simple example of fractured porous medium transport that has previously been analyzed by other methods. Then its utility is demonstrated in analyzing more complex cases of pulses of solute into a fractured matrix. The report serves as a user's guide to FRACPORT. A detailed description of data input, along with a listing of input for a sample problem, is provided. 16 references, 18 figures, 3 tables.

7547 **(SAND—83-2593) Three-dimensional geologic model of Yucca Mountain, southern Nevada.** Nimick, F.B.; Williams, R.L. (Sandia National Labs., Albuquerque, NM (USA)). Oct 1984. Contract AC04-76DP00789. 70p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85003478.

There is a need within the Nevada Nuclear Waste Storage Investigations (NNWSI) project for a comprehensive three-dimensional description of the subterranean geology of Yucca Mountain, Nevada. The model that is described is an initial version of a three-dimensional geometrical representation that can provide centralized and consistent information to the various tasks in the project. The initial implementation of the model is a collection of surface representations - one surface for the base of each stratigraphic zone. The primary method of surface definition is an analytical interpretation technique called Trend Modulation by Multikernel summation. The method was developed at Sandia National Laboratories for use with sparse and irregularly distributed input data such as that provided at Yucca Mountain. Comparison of predicted and actual elevations of geologic contacts in drill holes not used as input data indicates that the method predicted the elevations at those drill holes to within 71 feet or less with 95 percent confidence. Four representative geologic cross sections are presented, with a brief discussion. Regional trends suggested by other researchers are seen in some of the cross sections. 19 references, 8 figures, 17 tables.

7548 **(USGS/WRI—84-4193) Preliminary evaluation of hydrologic properties of cores of unsaturated tuff, test well USW H-1, Yucca Mountain, Nevada.** Weeks, E.P.; Wilson, W.E. (Geological Survey, Denver, CO (USA)). 1984. Contract AI08-78ET44802. 34p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85003099.

The unsaturated zone at Yucca Mountain, Nevada, is being evaluated as a potential repository for high-level nuclear wastes. Estimates of ambient moisture tension, effective hydraulic conductivity, and vertical flux are needed to design additional investigations and to develop preliminary models of the geohydrologic system. In deep unsaturated zones of uniform properties, hydraulic-head gradients are unity, and effective hydraulic conductivity may be used to estimate vertical flux. Analyses were made on 19 core samples of unsaturated tuff from test well USW H-1. Moisture-characteristic curves relating saturation and moisture tension were developed from results of mercury-injection tests. Ambient moisture tension estimated from these curves generally was 100 to 200 kilopascals. Values of relative permeability ranging from about 0.002 to 0.1 were determined by fitting an analytical expression to eight of the moisture-characteristic curves, and then integrating to solve for relative permeability. These values of relative permeability were applied to values of saturated hydraulic conductivity of core from a nearby test well to obtain effective hydraulic conductivities of about $8 \times 10^{-13}$ to $7 \times 10^{-10}$ centimeter per second. If a unit hydraulic-head gradient is assumed, these values convert to a vertical flux through the tuff matrix of 0.003 to 0.2 millimeter per year. The validity of this assumption was not verified due to the sparseness of data and uncertainties in their reliability. Consequently, the results of this study are preliminary and need to be used only as a guide for future studies. 9 references, 30 figures, 1 table.

7549 **(USGS/WRI—84-4253) Geohydrology of volcanic tuff penetrated by test well UE-25b No. 1, Yucca Mountain, Nye County, Nevada.** Lahoud, R.G.; Lobmeyer, D.H.; Whitfield, M.S. Jr. (Fenix and Scisson, Inc., Mercury, NV (USA); Geological Survey, Denver, CO (USA)). 1984. Contract AI08-78ET44802. 48p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85004341.

Test well UE-25b No. 1, located on the east side of Yucca Mountain in the southwestern part of the Nevada Test Site, was drilled to a total of 1220 meters and hydraulically tested as part of a program to evaluate the suitability of Yucca Mountain as a nuclear-waste repository. The well penetrated almost 46 meters of alluvium and 1174 meters of Tertiary volcanic tuffs. The composite hydraulic head for aquifers penetrated by the well was 728.9 meters above sea level (471.4 meters below land surface), with a slight decrease in hydraulic head with depth. Average hydraulic conductivities for stratigraphic units determined from pumping tests, borehole-flow surveys, and packer-injection tests ranged from less than

0.001 meter per day for the Tram Member of the Crater Flat Tuff to 1.1 meters per day for the overlying Bullfrog Member of the Crater Flat Tuff. Small values for the Tram Member represented matrix permeability of unfractured rock; large values near the lower part of the Bullfrog Member were associated with the basal bedded or reworked tuffaceous beds, but probably resulted from fracture permeability. Large hydraulic conductivities of the rhyolitic tuffs of Calico Hills, the Prow Pass Member at the top of the Crater Flat Tuff, and the middle of the Bullfrog Member probably resulted from fracture permeability in the ash-flow tuffs. Chemical analyses indicated that the water is a soft sodium bicarbonate type, slightly alkaline, with large concentrations of dissolved silica and sulfate. Uncorrected carbon-14 age dates of the water were 14,100 and 13,400 years. 25 references, 26 figures, 5 tables.

## 5802 Geophysics

*REFER ALSO TO CITATION(S) 5802006416, 6508, 6690*

7550 **(NP—5770107) Evaluation of microseismograms.** Neupert, F. (Technische Univ. Braunschweig (Germany, F.R.). Inst. fuer Geophysik und Meteorologie). Apr 1984. 219p. (In German). NTIS (US Sales Only), PC A10/MF A01;1. File Number DE85770107.

In seismic prospecting the acoustic log method is important for the determination of the propagation velocity of elastic waves. By this procedure it is possible to determine the velocity continuously over the depth range. The measurements are made in a scavenged borehole by a probe, which contains one (or more) ultrasound transmitters and receivers in distinct distances.

7551 **Tilt and seismicity changes in the Shumagin seismic gap.** Beavan, J.; Hauksson, E.; McNutt, S.R.; Bilham, R.; Jacob, K.H. (Columbia Univ., Palisades, NY). *Science (Washington, D.C.);* **222**: 322-325(21 Oct 1983).

Changes in the ground surface tilt and in the rate of seismicity indicate that an aseismic deformation event may have occurred between 1978 and 1980 along the plate boundary in the eastern Aleutians, Alaska, within the Shumagin seismic gap. Pavlof Volcano was unusually quiescent during this period. The proposed event would cause an increase of stress on the shallow locked portion of the plate boundary, bringing it closer to rupture in a great earthquake.

## 5803 Mineralogy, Petrology, And Rock Mechanics

*REFER ALSO TO CITATION(S) 5803006468, 6507, 6522*

7552 **(SAND—84-0126C) Saturated permeability measurements on pumice and welded-tuffaceous materials.** Reda, D.C.; Hadley, G.R. (Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 13p. (CONF-850101—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85001358.

From International congress on hydrology of rocks of low permeability; Tucson, AZ, USA (7 Jan 1985).

An experimental apparatus was designed and built to allow water-saturated permeabilities as low as $10^{-18}$ $m^2$ to be measured on cores of diameter 5 cm and length 10 cm under steady-state flow conditions. This same apparatus can also be utilized in a transient (pressure-decay) mode in order to measure permeabilities several orders of magnitude lower than the steady-state limit. Tests were conducted on samples of pumice, fractured welded tuff, and welded tuff, representing a permeability range of seven orders of magnitude. Based on present measurements and calculations, the following results were obtained: Liquid-saturated permeability of the pumice core from Mount St. Helens was $2.76 \times 10^{-12}$ $m^2$; the corresponding Ergun constant was $4.43 \times 10^{11}$ $kg/m^4$. The ultimate compressive strength of this material was found to be greater than 1.8 MPa, but less than 3.6 MPa; liquid-saturated permeability of the unfractured welded-tuff core was $5.6 \times 10^{-19}$ $m^2$; liquid-saturated permeability for the fractured welded-tuff core was found to decay to $2 \times 10^{-18}$ $m^2$ after long-time-scale exposures to continuous-flow and applied-load conditions, independent of the initial fracture state (open vs closed); with an initially closed (naturally existing) fracture, core permeability decreased by a factor of about 2 over a 200-h test period; with an initially open fracture, core permeability decreased by a factor of about 4 under the influence of a comparable load-time history to that experienced in the natural-fracture test; final core permeability was found to be reduced by an order of magnitude from its initial level during a total 700-h test period; and the final effective hydraulic fracture aperture was calculated to be $10^{-6}$ m for both tests on the fractured welded-tuff core; the final effective fracture permeability was calculated to be $10^{-13}$ $m^2$, five orders of magnitude greater than the matrix-material prmeability. 28 references, 10 figures.

7553 **(UCID—20273) Ultrasonic velocities and dynamic elastic moduli of Mesaverde rocks.** Lin, W. (Lawrence Livermore National Lab., CA (USA)). Nov 1984. Contract W-7405-ENG-48. 50p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85004408.

Ultrasonic P-wave and S-wave velocities were measured in Mesaverde sandstones and shales as function of confining pressure to 650 MPa, in six directions concurrently. The samples came from five wells in Colorado and Wyoming. The Mesaverde sandstones are quite isotropic; the shales are transversely isotropic with the direction perpendicular to bedding being the slow direction for wave propagation. The anisotropy of the shale is up to 13% for P-waves and 17% for S-waves. The velocity-pressure behavior of these rocks reveals microscopic structural differences between the sandstones and shales. The sandstones contain microcracks that are closed at moderate pressures (less than 100 MPa). The shales do not have the obvious discontinuity in the pressure/velocity record that can be attributed to the microcrack closing. In situ velocities obtained from the well logs of four of the five wells are compatible with the laboratory determined velocities. Dynamic elastic moduli of the rocks at the overburden pressures (8 to 98 MPa) were calculated from the wave velocities and bulk density. They are greater than the static elastic moduli by 50 to as much as 600%. The dynamic Poisson's ratios are much smaller than the static ones. Some of the calculated dynamic Poisson's ratios have small negative values. 19 references, 25 figures, 5 tables.

7554 **(UCRL-Trans—12017) Lapis lazuli of Sar-e-Sang (Badakshan, Afghanistan).** Wyart, J.; Bariand, P.; Filippi, J. Translated from *Revue de Geographie Physique et de Geologie Dynamique ;* **14**: No. 4, 443-448(1972). Contract W-7405-ENG-48. 15p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85001830. DE85001830

The lapis lazuli deposit of Sar-e-Sang, in Badakshan, Afghanistan, has furnished the raw material for precious objects manufactured since the earliest civilizations. The mine, which is located in the Hindu Kush Mountains, is always difficult to reach, and is open for only a few months during the summer. The lenses mined are included in very hard cipolins in which calcite and dolomite are intimately associated with silicates such as diopside, scapolite, and forsterite. Pyrite is always present. These minerals, with calcite, occur in varying quantities along with the pure mineral, lazurite, in the lapis lazuli, whose color varies with the amount of impurities it contains. Wellformed crystals with the dominant (110) form are rare. An explanation of the genesis of lapis lazuli is proposed. 17 references, 1 figure.

## 5804 Geochemistry

*REFER ALSO TO CITATION(S) 5804006465, 6487, 6518*

7555 **(CONF-841248—1) Evaluation of radionuclide geochemical information for Department of Energy candidate high-level waste repositories.** Kelmers, A.D.; Seeley, F.G.; Arnold, W.D.; Meyer, R.E.; Smith, F.J.; Jacobs, G.K.; Lee, S.Y. (Oak Ridge National Lab., TN (USA)). 1984. Contract AC05-84OR21400. 6p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85003337.

From Geochemistry of radionuclide migration meeting; Oak Ridge, TN, USA (6 Dec 1984).

The experimental work to date has investigated the behavior of technetium, neptunium, and uranium since these may be among the more important key radionuclides. Batch contact methodology

under experimental conditions representative of the repository far field are being conducted in order to determine the sorption isotherm and apparent concentration limit. Some column chromatographic experiments are being carried out to explore sorption/desorption disequilibrium and the effects of multiple species or forms of radionuclides.

7556 (INIS-mf—9071, pp 59) **Temporal changes of the radium contents of mineral, medicinal and thermal waters in Hungary.** Somfai, M. (Baranya Megyei Koezegeszseguegyi es Jarvanyuegyi Allomas, Pecs (Hungary)); Elek, I. (Mecseki Ercbanyaszati Vallalat, Pecs II (Hungary)). 1984. (In Hungarian). NTIS (US Sales Only), PC A04/MF A01. File Number TI85780132. (CONF-8404195—Summ.).

From Training course on radiation protection; Balatonkenese, Hungary (11 Apr 1984).

7557 **(INIS-mf—9094) Variations in uranium and radioactivity levels in surface and ground water at selected sites in British Columbia, April 1980 - March 1981.** (British Columbia Ministry of Energy, Mines and Petroleum Resources, Victoria (Canada); British Columbia Ministry of Health, Victoria (Canada); Chemex Labs Ltd., North Vancouver, British Columbia (Canada)). Jul 1981. 53p. NTIS (US Sales Only), PC A04/MF A01. File Number DE85780135.

This report summarizes field and analytical work carried out between April, 1980 and March, 1981 on a program to investigate uranium and radioactivity levels in potable surface and ground water in selected regions throughout British Columbia.

# 64 PHYSICS. I.

## 6401 Astrophysics And Cosmology

*REFER ALSO TO CITATION(S) 6401007663, 7809*

7558 **(ITEF—109(1983)) Hydrodynamics in deflagrational models of supernova bursts.** Ivanova, L.N.; Chechetkin, V.M.; Imshennik, V.S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1983. 48p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. File Number DE85700126.

There are considered results of the hydrodynamical computations of a thermonuclear explosion for two variants of initial density in the star center: rhosub(c)=5x10sup(9) g/cm$^3$ and rhosub(c)=3.5x10sup(9) g/cm$^3$. Taking into account previous results for a variant with rhosub(c)=2.34x10$^9$ g/cm$^3$ it becomes possible to draw some wellgrounded conclusions concerning the general picture of a thermonuclear explosions of a degenerated carbon core with an arbitrary initial density satisfying the above inequality. The following conclusions seem to be most important: 1) the carbon burning takes place in the deflagration regime accompanied by a series (about ten) of stellar pulsations and by a considerable neutronization of the burnt matter; 2) not all carbon is burnt (not more than half a stellar mass, i. e. 0.7 Msub(Sun)); 3) no stellar remnant is left behind the thermonuclear explosion and the burning never proceeds through the detonation regime. The deflagration model of a supernova outburst (as we briefly denote the present series of computations) leads to the total final energy of explosion of (2-5)x10$^{50}$ ergs in good agreement with the oberserved energy of supernovae. In final section there are discussed various possible scenarios of supernova outbursts based both on the computations of thermonuclear explosion (or collapse) of a stellar core and on the theory of propagation of shock and thermal waves through the steelar envelope.

7559 (Juel-Spez—255, pp 107-108) **Electron capture in stellar collapse.** Cooperstein, J.; Wambach, J. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

7560 **(LA-UR—84-3330) Application of dimensional analysis to the problem of solar wind-magnetosphere energy coupling.** Bargatze, L.F.; McPherron, R.L.; Baker, D.N.; Hones, E.W. Jr. (California Univ., Los Angeles (USA). Dept. of Earth and Space Sciences; Los Alamos National Lab., NM (USA)). 1984. Contract W-7405-ENG-36. 5p. (CONF-8406150—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85002414.

From Symposium on the achievements of IMS; Graz, Austria (26 Jun 1984).

The constraints imposed by dimensional analyses are used to find how the solar wind-magnetosphere energy transfer rate depends upon interplanetary parameters. The analyses reported here assume that only magnetohydrodynamic processes are important in controlling the rate of energy transfer. The study utilizes ISEE-3 solar wind observations, the AE index, and U/sub T/ from three 10-day intervals during the IMS: Simple linear regression and histogram techniques are used to find the value of the MHD coupling exponent, $\alpha$, which is consistent with observations of magnetospheric response. Once $\alpha$ is estimated, the form of the solar wind energy transfer rate is obtained by substitution into an equation of the interplanetary variables whose exponents depend upon $\alpha$. 7 references, 6 figures, 1 table.

7561 **(LA-UR—84-3469) Fragmentation and turbulence in collapsing gas clouds.** Benz, W. (Los Alamos National Lab., NM (USA)). 30 Oct 1984. Contract W-7405-ENG-36. 35p. (CONF-850135—1). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85003745.

From American Astrophysical Society meeting; Tucson, AZ, USA (13 Jan 1985).

We present four simulations of the collapse of uniformly rotating isothermal gas clouds using the smoothed particle hydrodynamics method to solve the hydrodynamical equations. In all cases the result is a central disk-like massive object surrounded by many less massive fragments located in the equatorial plane, collapsing on their own and carrying most of the angular momentum. The origin of these structures is found to be Jeans and Rayleigh-Taylor instabilities seeded from a small random initial perturbation spectrum. We also show that in each simulation turbulent motions are generated from the input of gravitational energy. By analyzing these motions we found that a turbulent spectrum with a slope about 0.5 always develops very rapidly and remains constant through the rest of the collapse. Only a very little dependence on initial conditions of this slope was found. It is shown that turbulence may slow down the collapse by a factor up to 10$^3$, and that the time scale for turbulence dissipation is a better characteristic time scale for star formation than the free-fall time. It is also suggested that the roughly constant initial mass function found in various regions may be a result of the turbulence.

7562 **(PPPL—2166) Application of the MHD energy principle to magnetostatic atmospheres.** Zweibel, E.G. (Princeton Univ., NJ (USA). Plasma Physics Lab.; Colorado Univ., Boulder (USA). Dept. of Astrophysical, Planetary, and Atmospheric Sciences). Nov 1984. Contract AC02-76CH03073. 23p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85004398.

We apply the MHD energy principle to the stability of a magnetized atmosphere which is bounded below by much denser fluid, as is the solar corona. We treat the two fluids as ideal; the approximation which is consistent with the energy principle, and use the dynamical conditions that must hold at a fluid-fluid interface to show that if vertical displacements of the lower boundary are permitted, then the lower atmosphere must be perturbed as well. However, displacements which do not perturb the coronal boundary can be properly treated as isolated perturbations of the corona alone.

7563 **(RRK—83-3) Gravitational mass and angular momentum of two black holes in equilibrium.** Tomimatsu, Akira. (Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics). Mar 1983. 18p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700127.

We investigate the Komar integrals for the metric describing a nonlinear superposition of two Kerr-NUT metrics. This metric can be interpreted as a system of two black holes in equilibrium. We define the gravitational mass and angular momentum of each black hole by the surface integrals over each horizon, and observe the effect of their gravitational spin-spin interaction. Moreover, we discuss the problem whether the gravitational masses obtained here are positive or not. If the metric fails to satisfy the condition of elementary flatness on the part of the axis between the two horizons, the peculiar property of this region is studied from the viewpoint of the Komar integrals.

7564 **(RRK—83-6) Evolution of an inflationary universe.** Tomita, Kenji. (Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics). Jun 1983. 30p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85700128.

The evolution of an inflationary universe with radiatively induced symmetry breaking is considered. After the classical part phi of the Higgs field passed over the barrier of the effective potential, phi rolls down towards the bottom, dissipating part of the vacuum energy. It is shown that enormously long exponential expansion is required in order that the vacuum energy is exhausted. Moreover gravitational instability at this super-inflationary stage is examined and it is shown that gravitational-wave perturbations survive at this stage and the secondary density perturbations aroused by them can have the values interesting from the point of galaxy formation.

7565 **Classical Kaluza-Klein cosmology for a torus space with a cosmological constant and matter.** Tosa, Y. (Theory Division, T-8, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review [Section] D: Particles and Fields;* **30**: No. 10, 2054-2060(15 Nov 1984).

A complete analysis is done for the classical Kaluza-Klein cosmology with a torus space, a cosmological constant, and matter. We show that only a negative cosmological constant with the extra dimension greater than one can provide an inflation and the entropy production in our space.

7566 **Monopole catalyzed nucleon decay: The astrophysical connection.** Kolb, E.W. (Fermi National Accelerator Lab., Batavia, IL). pp 239-249 of Monopole '83. Stone, J.L. New York, NY, USA; Plenum Press (1984). (CONF-8310227—).

From Monopole '83 conference; Ann Arbor, MI, USA (6 Oct 1983).

This chapter examines the limits on the product of the monopole flux and the catalysis cross section resulting from "astrophysical" considerations if monopoles catalyze nucleon decay. Ways of limiting the luminosity of neutron stars are discussed. The total energy released by the monopoles in the neutron star is proportional to the number of monopoles in the star.

7567 **Progress and prospects for the inflationary universe.** Steinhardt, P.J. (Univ. of Pennsylvania, Philadelphia, PA). pp 85-106 of Monopole '83. Stone, J.L. New York, NY, USA; Plenum Press (1984). (CONF-8310227—).

From Monopole '83 conference; Ann Arbor, MI, USA (6 Oct 1983).

This chapter examines a radically new model of the evolution of the universe which is designed to resolve many of the problems of the standard model of cosmology (the hot big bang picture). While the inflationary universe agrees with the hot big bang model with regard to the expansion of the universe for all times greater than one second or so after that big bang, the two cosmologies differ in their descriptions of the first instants after the birth of the universe. The experimentally testable "predictions" of the inflationary universe scenario are reassessed. Recent progress in obtaining a workable inflationary model based on supersymmetric field theories is discussed. Topics considered include the horizon problem, the flatness problem, monopole and domain wall problems, the inhomogeneity (galaxy formation) problem, and the slow rollover phase transition.

7568 **Superheavy magnetic monopoles and the standard cosmology.** Turner, M.S. (Fermi National Accelerator Lab., Theoretical Astrophysics Group, Batavia, IL). pp 61-83 of Monopole '83. Stone, J.L. New York, NY, USA; Plenum Press (1984). (CONF-8310227—).

From Monopole '83 conference; Ann Arbor, MI, USA (6 Oct 1983).

The superheavy magnetic monopoles predicted to exist in grand unified theories (GUTs) are very interesting objects, both from the point of view of particle physics, as well as from astrophysics and cosmology. Astrophysical and cosmological considerations have proved to be invaluable in studying the properties of GUT monopoles. Because of the glut of monopoles predicted in the standard cosmology for the simplest GUTs (so many that the Universe should have reached a temperature of 3 K at the tender age of $\simeq$ 10,000 yrs), the simplest GUTs and the standard cosmology are not compatible. This is a very important piece of information about physics at unification energies ($E \geqq 10^{14}$ GeV) and about the earliest moments ($t \leqq 10^{-34}$ s) of the Universe.

7569 **Primordial inflation and the monopole problem.** Olive, K.A.; Seckel, D. (Theoretical Astrophysics Group, Fermi National Accelerator Lab., Batavia, IL). pp 107-116 of Monopole '83. Stone, J.L. New York, NY, USA; Plenum Press (1984). (CONF-8310227—).

From Monopole '83 conference; Ann Arbor, MI, USA (6 Oct 1983).

This chapter discusses the cosmological abundance of magnetic monopoles in locally supersymmetry grand unified theories (GUTs) and primordial inflation. It is shown how the magnetic monopole problem can be solved in variants of broken N=1 supergravity primordial inflation. The monopole problem and its solution in inflationary models is reviewed. It is demonstrated that the monopole problem can be solved by coupling primordial inflation to supersymmetric SU(5) breaking.

7570 **Problems in the analysis of gamma-ray burst spectra.** Fenimore, E.E.; Klebesadel, R.W.; Laros, J.G. (Los Alamos National Lab., NM). *Advances in Space Research;* **3**: 207-210(1983).

Gamma-ray spectra of burst GB800419 (on Apr. 19, 1980) obtained with the SMM Goddard hard-X-ray burst spectrometer and with ISEE-3 are intercompared, with a focus on the effects of the spectrum-unfolding techniques employed. It is shown that the cyclotron absorption lines in the SMM spectrum (at around 65 keV), not present in the ISEE-3 spectrum, are probably an artifact of the optically-thin-thermal-bremsstrahlung spectral shape presupposed in the SMM unfolding process, since they disappear when an exponential shape presupposed in the SMM unfolding process since they disappear when an exponential shape is used to fit the data. Any narrow absorption, features appearing in the 50-keV region of the SMM spectra when harder spectral shapes (such as those consistent with a Comptonized-black-body mechanism) are used in the unfolding remain in disagreement with the ISEE-3 findings. It is pointed out that all of the instruments used are prone to errors in the 45-65-keV range.

## 6403 Atomic, Molecular, And Chemical Physics

*REFER ALSO TO CITATION(S) 6403006430, 6430, 7185, 7220, 7252, 7910*

7571 **(DOE/ER/13000—T3) Structural studies of sputtered Ni-As-O films.** Laderman, S.S.; Bienenstock, A.; Flasck, R.; Betts, F. (Stanford Univ., CA (USA). Dept. of Materials Science and Engineering; Energy Conversion Devices, Inc., Troy, MI (USA); Hospital for Special Surgery, New York (USA)). [1984]. Contract AC03-82ER13000. 34p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85003229.

The combined results of chemical analysis, x-ray difraction and extended x-ray absorption fine structure (EXAFS) studies demonstrate that the majority of Ni atoms in sputtered Ni-As-O films are best described as covalently bonded to six As stoms in a noncrystalline phase. The arrangement of nearest neighbors about the Ni atoms is very similar to that found in crystalline $NiAs_2$.

7572 **(IAE—3752/1) Polarization mechanism of parity nonconservation in light muonic atoms. To the problem of weak neutral muon-nucleon interaction observation.** Romanov, S.V.; Grechukhin, D.P. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1983. 52p. (In Russian). NTIS (US Sales Only), PC A04/MF A01. File Number DE84703231.

The effect of parity nonconservation of the 2s orbit of muonic atoms showing in an angular distribution of W(THETA)=1 + α cos THETA for quanta emitted by a polarized mesic atom in the 2s → 1s transition is estimated for $\mu^{19}F_9$, $\mu^{21}Ne_{10}$, $\mu^{23}Na_{11}$ and $\mu^{20}Ne_{10}$ mesic atoms. The effect of weak neutral interaction of a muon and a nucleus and the polarization mechanism of parity nonconservation of mesic atom states caused by parity nonconservation in nuclear state due to weak nucleon-nucleon interaction are considered. In estimations the states of a shell model with configuration mixing as well as the Nilsson model are Used. The analysis confirms the conclusion of a possibility of experimental observation of the effects of weak neutral interactions of a muon and a nucleus in μNe, μNae μF mesic atoms, and sodiUm fluoride can be Used as a suitable target.

7573 **(INIS-mf—9075) Model calculation of psub(L) (O).** Sulik, B.; Hock, G.; Berenyi, D. (Magyar Tudomanyos Akademia, Debrecen. Atommag Kutato Intezete). Feb 1984. 17p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85780124.

A simple encounter probability model for approximating the mean L-shell ionization probability at zero impact parameter, psub(L) (O) used in the multiple ionization theories of heavy-ion collisions is developed. The model establishes a simple scaling rule for psub(L) (O) as a function of $Z_1$/vsub(i) which behaves asymptotically as psub(L) (O) approx. $(Z_1/vsub(i))^2$ for low projectile charge $Z_1$ and tends to unite for high $Z_1$ values in the high speed limit vsub(i)>>vsub(a).

7574 **(INS—471) Thermalization of central products in ultra-relativistic heavy ion collisions.** Ochiai, T.; Date, S.; Suzuki, N.; Miyamura, O.; Sumiyoshi, H. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). May 1983. 17p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700141.

Average number of collisions per particle and the energy density are calculated for the central products in ultra-relativistic heavy ion collisions based on the multi-chain model. Within a rather short time after the collision, enough collisions per particle take place in the system keeping sufficient energy density for the phase transition to quark-gluon matter when the incident energy and the mass number are appropriately high and large.

7575 (Juel-Spez—255, pp 14-15) **Measurements of electron capture and stripping cross sections for Al, Ni, Ag and Au targets at 68, 99 and 130 MeV $^3$He beams.** Katayama, I.; Gaul, G.; Hasai, H.; Huerlimann, W.; Berg, G.P.A.; Martin, S.A.; Meissburger, J.; Oelert, W.; Rogge, M.; Retz, A. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

7576 (Juel-Spez—255, pp 83) **Effect of nuclear polarization on the isotope shift in electronic atoms.** Hoffmann, B.; Baur, G.; Speth, J. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

7577 (Juel-Spez—255, pp 105) **Inner shell ionization processes in asymmetric collision systems.** Baur, G.; Roesel, F.; Trautmann, D. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

7578 (Juel-Spez—255, pp 105-106) **Excitation of inner shells in collisions of charged particles with atoms.** Hoffmann, B.; Baur, G. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

7579 (KEK—82-3, pp 149-153) **Electron impact desorption of low temperature adsorbed and condensed gas.** Arakawa, Ichiro; Tuzi, Yutaka (Tokyo Univ. (Japan). Inst. of Industrial Science). Jun 1982. (In Japanese). NTIS (US Sales Only), PC A09/MF A01. File Number TI85780074. (CONF-8203186—).

From 4. meeting on ultra high vacuum techniques for accelerators and storage rings; Oho, Ibaraki, Japan (12 Mar 1982).

The electron stimulated desorption of Xe gas condensed on the surface of a polycrystalline copper was studied. The kinds of desorbed particles and their energy were measured by the time of flight (TOF) and the stopping potential method. The copper was cooled by a cryostat, and the temperature of 40 K was stably obtained. The electron stimulation was made by a commercially available electron gun. Desorbed ions and excited neutral particles were measured by a secondary electron multiplier. The vacuum pumps used were a turbomolecular pump and a tantalum getter pump. The minimum pressure of the system was 5 x $10^{-8}$ Pa. The experimental results were as follows. The desorption of neutral Xe, $Xe^+$ and $Xe^{2+}$ was observed. Most of the desorbed particles were multiple-charge Xe ions with 1.5 to 2 eV of energy-to-charge ratio. The yield of desorption per incident electron was in the range of $10^{-4}$ to $10^{-5}$ for total desorption yield, and about $10^{-6}$ for multiple-charge Xe ions.

7580 **(KFKI—1984-25) Thermodynamics of systems of non-equilibrium momentum distribution.** Lukacs, B.; Martinas, K. (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). Mar 1984. 25p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700144.

There exist physical processes, e.g. in energetic heavy ion collisions, where the time scale of the process is not sufficiently long to reach complete thermal equilibrium. The authors show a way to extend the thermodynamical formalism for nonequilibrium situations. The results are compatible with continuum mechanics.

7581 **(ORNL—6095) Bibliography of atomic and molecular processes, 1983.** Barnett, C.F.; Crandall, D.H.; Gilbody, H.B.; Gregory, D.C.; Kirkpatrick, M.I.; McDaniel, E.W.; McKnight, R.H.; Meyer, F.W.; Morgan, T.J.; Phaneuf, R.A. (comps.). (Oak Ridge National Lab., TN (USA)). Oct 1984. Contract AC05-84OR21400. 215p. NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE85000662.

This annotated bibliography includes papers on atomic and molecular processes published during 1983. Sources include scientific journals, conference proceedings, and books. Each entry is designated by one or more of the 114 categories of atomic and molecular processes used by the Controlled Fusion Atomic Data Center, Oak Ridge National Laboratory to classify data. Also indicated is whether the work was experimental or theoretical, what energy range was covered, what reactants were investigated, and the country of origin of the first author. Following the bibliographical listing, the entries are indexed according to the categories and according to reactants within each subcategory.

7582 **(PNL-SA—12414) Coincidence techniques to study electron emission in ion-atom collisions.** DuBois, R.D. (Pacific Northwest Lab., Richland, WA (USA)). Nov 1984. Contract AC06-76RL01830. 15p. (CONF-841117—24). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003635.

From 8. conference on the application of accelerators in research and industry; Denton, TX, USA (12 Nov 1984).

Electron emission as a function of emission angle and electron energy provides a very sensitive probe for testing our theoretical understanding of ion-atom collisions. For fast proton impact on gaseous targets the Born approximation has been shown to work quite well. However, for structured particle impact a comparison with theory is more difficult. The experimental observation of the

total electron emission must be compared with the sum of the theoretical calculations for projectile only, target only, and simultaneous projectile-target ionization. Thus the author will discuss a set of experiments where the electron emission is being recorded in coincidence with the post-collision projectile charge state. $He^+$-Ar is being studied for impact energies between 1 and 2 MeV. Coincidences between emitted electrons and stripped projectiles provide information about projectile ionization while information about simultaneous projectile-target ionization is obtained from stripped projectile - target ion coincidences.

7583 **Evidence for a phenomenological supersymmetry in atomic physics.** Kostelecky, V.A.; Nieto, M.M. (Theoretical Division, University of California, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review Letters;* **53**: No. 24, 2285-2288(10 Dec 1984).

We show that supersymmetric quantum mechanics may be used to interrelate the spectra of different atoms and ions. This supersymmetry is broken by electron-electron interactions.

7584 **Wavelength-dependent fragmentation in the resonance-enhanced ionization of bromobenzene.** Koplitz, B.D.; McVey, J.K. (Princeton University, Department of Chemistry, Princeton, New Jersey 08544). *Journal of Chemical Physics;* **81**: No. 11, 4963-4968(1 Dec 1984).

The ionic fragmentation of bromobenzene is studied as a function of excitation energy into the $^1B_2$ state, with two UV photons being necessary to ionize the neutral molecule. A mass-resolved analysis reveals an increase in the $C_6H^+_5/C_6H_5Br^+$ ratio at lower excitation energies, which can be traced to a larger photodissociation cross section for the parent ion. Selected resonant and off-resonant features of the $^1B_2$ state also have been excited. Surprisingly, a slightly smaller phenyl/parent ion ratio is observed for a resonant excitation as compared with an off-resonant excitation. An additional ionization pathway through a triplet state is discussed as a possible explanation of the observed reduction in the phenyl/parent ratio.

7585 **Near-edge x-ray-absorption fine-structure studies of chemisorbed hydrocarbons: Bond lengths with a ruler.** Stoehr, J.; Sette, F.; Johnson, A.L. (Cor- porate Research Science Laboratories, Exxon Research and Engineering Company, Annandale, New Jersey 08801). *Physical Review Letters;* **53**: No. 17, 1684-1687(22 Oct 1984).

Starting from an established correlation between the $\sigma$ shape resonance position in near-edge x-ray absorption fine-structure spectra and the intramolecular C-C bond length for gas-phase hydrocarbons, we derive a similar relation for chemisorbed molecules. The linear relation obtained allows us to determine the C-C bond length for chemisorbed molecules from near-edge x-ray-absorption fine-structure spectra with a ruler to an accuracy of $<0.04$ A. Examples are given for bonding and bond-length changes of $C_6H_6$ and $C_2H_4$ on Pt(111).

7586 **Modulated electron beam.** Anderson, R.A. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **2**: No. 4, 1607-1607(Oct 1984). Contract AC04-76DP00789.

An easily installed modification to an electron gun power supply allows the electron beam to be modulated with an externally applied, audio-frequency signal. Full on—off chopping is accomplished with an input amplitude of only 10 V rms. The modification does not interfere with normal operation of the electron gun.

7587 **Observation of quartet-state fine structures and lifetimes in lithiumlike Ne VIII.** Livingston, A.E.; Hardis, J.E.; Curtis, L.J.; Brooks, R.L.; Berry, H.G. (Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review [Section] A: General Physics;* **30**: No. 4, 2089-2092(Oct 1984). Contract W-31-109-ENG-38.

Wavelength and lifetime measurements for the fine-structure components of the 1s2s2p $^4$P/sup o/—1s2p$^2$ $^4$P multiplet in lithiumlike Ne VIII have been made using foil excitation of a fast-ion beam. The results are compared with recent theoretical calculations and with previous measurements for other ions of the same isoelectronic sequence. An apparent discrepancy between theory and experiment for the 1s2p$^2$ $^4$P/sub 3/2/ lifetime is removed.

7588 **Photoelectron angular distributions from multiphoton ionization of cesium atoms.** Compton, R.N.; Stockdale, J.A.D.; Cooper, C.D.; Tang, X.; Lambropoulos, P. (Chemical Physics Section, Health and Safety Research Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Physical Review [Section] A: General Physics;* **30**: No. 4, 1766-1774(Oct 1984). Contract W-7405-ENG-26.

We present both experimental and theoretical studies of resonantly enhanced multiphoton ionization of cesium atoms. Photoelectron angular distributions for two-photon ionization via the one-photon-allowed 7p $^2$P/sub 1/2,3/2/ and 8p $^2$P/sub 1/2,3/2/ intermediate states and three-photon ionization via the two-photon-allowed 8d $^2$D/sub 5/2,3/2/ resonant intermediate states are reported. The photoelectrons are energy analyzed with a spherical-sector electrostatic energy analyzer with an energy resolution of $\sim$0.1 eV and angular resolution of $\sim$ +- 2$^0$. A straightforward calculation based upon a fine-structure scheme gives excellent agreement with the measured angular distributions for the $^2$P/sub 1/2/ states. The laser pulse duration is comparable to the hyperfine precession period which allows the hyperfine coupling to partially destroy the anisotropy initially produced in the $^2$P/sub 3/2/ resonant intermediate states. Quantitative calculations including hyperfine coupling take this into account and provide an expression which gives a reasonable fit to the $^2$P/sub 3/2/ data.

7589 **Near-infrared multiphoton ionization of cesium.** Christian, W.; Compton, R.N.; Stockdale, J.A.D.; Miller, J.C.; Cooper, C.D.; Tang, X.; Lambropoulos, P. (Chemical Physics Section, Health and Safety Research Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physical Review [Section] A: General Physics;* **30**: No. 4, 1775-1782(Oct 1984). Contract W-7405-ENG-26.

Experimental and theoretical results are presented for resonantly enhanced three-photon ionization of cesium atoms in the wavelength range from 830 to 950 nm. The accidental near resonance of the 6p $^2$P/sub 3/2,1/2/ levels at the one-photon energy and the near resonance at the two-photon level with the 6d $^2$D/sub 3/2,5/2/ states gives rise to large ionization signals and interesting anomalies in the relative intensities of the fine-structure levels. "Hybrid resonances" are observed which involve the production of 6p $^2$P/sub 1/2/ atoms from molecular cesium. One hybrid resonance involves ionization of the 6p $^2$P/sub 1/2/ state via an electric quadrupole transition (6p $^2$P/sub 1/2/—7p $^2$P/sub 3/2/). Both experimental and theoretical photoelectron angular distributions are compared for all of the observed resonances except for the 6p $^2$P/sub 3/2/ state where the signals were too weak for such a measurement. Agreement between experiment and theory is fair for three-photon ionization via the 6p $^2$P/sub 1/2/ state. Comparison of experiment and theory for the case of the 6d $^2$D/sub 3/2,5/2/ states indicates that hyperfine coupling during the laser-pulse duration may be important. The angular distributions for the hybrid resonances show the general behavior predicted by theory but the features appear broadened.

7590 **ac Stark shifts for cesium and their effect on ionization line shapes.** Pindzola, M.S.; Glasser, A.H.; Payne, M.G. (Department of Physics, Auburn University, Auburn, Alabama 36849). *Physical Review [Section] A: General Physics;* **30**: No. 4, 1800-1804(Oct 1984).

The influence of ac Stark shifts on the three-photon ionization of cesium in a moderate-intensity laser beam is investigated. The ionization process involves a two-photon resonance with the 8d fine-structure levels. The work consists of two related parts. In the first part, atomic parameters, such as the two-photon Rabi rate and the ac Stark shift, are calculated in the nonrelativistic Hartree-Fock approximation. In the second part, the atomic parameters thus obtained are used as coefficients in a system of coupled differential equations representing the time evolution of the density matrix. Ionization line shapes are generated for a transform-limited pulsed laser of moderate intensity with a single-mode transverse structure. As the time history of the intensity profile is varied from square to smooth, the ionization line shape becomes asymmetric due to the

time dependence of the ac Stark shift. The effects of varying the spatial intensity distribution of the laser light to include transverse centering and longitudinal focusing are also studied.

7591 **Trithallium tetraselenophosphate $Tl_3PSe_4$, and trithallium tetrathioarsenate, $Tl_3AsS_4$, by neutron time-of-flight diffraction.** Alkire, R.W.; Vergamini, P.J.; Larson, A.C.; Morosin, B. (Los Alamos National Lab., NM). *Acta Crystallographica, Section C: Crystal Structure Communications;* **40**: No. 9, 1502-1506(15 Sep 1984).

Room-temperature (293 K) single-crystal structure determinations of the isostructural materials $Tl_3PSe_4$ and $Tl_3AsS_4$ were performed at the Los Alamos National Laboratory Pulsed Neutron Facility. For $Tl_3PSe_4$: Msub(r) = 959.92, Pcmn, a = 9.276 (1), b = 11.036 (2), c = 9.058 (1) A, V = 927.27 $A^3$, Z = 4, Dsub(m) = 6.87 (2), Dsub(x) = 6.876 Mg $m^{-3}$, lambdasub(neutron) = 0.5 → 5.2 A, F(000) = 252.5 fm. For $Tl_3AsS_4$: Msub(r) = 816.29, Pcmn, a = 9.084 (3), b = 10.877 (3), c = 8.877 (3) A, V = 877.11 $A^3$, Z = 4, Dsub(m) = 6.18 (2), Dsub(x) = 6.181 Mg $m^{-3}$, lambdasub(neutron) = 0.5 → 5.2 A, F(000) = 177.2 fm. For $Tl_3PSe_4$ ($Tl_3AsS_4$), 1929 (1013) reflections were measured with I > 3sigma(I) and refined by full-matrix least squares to R(F) = 0.061 (0.063). Results on atomic refinement from this study represent an order of magnitude increase in precision over previous single-crystal X-ray structural work using Mo Kα radiation. The $PSe_4^{3-}$ ($AsS_4^{3-}$) groups have essentially tetrahedral configurations and one $Tl^+$ ion shows large anisotropic thermal motion which is structure related.

7592 **Pionic M X-rays of sup(166,168)Er and $^{176}$Hf.** Tanaka, Y.; Steffen, R.M.; Shera, E.B.; Reuter, W.; Hoehn, M.V.; Zumbro, J.D. (Purdue Univ., Lafayette, IN). *Physics Letters, [Section] B;* **143**: No. 4-6, 347-350(16 Aug 1984).

The X-rays energies and widths of the pionic 4f -> 3d transitions (M X-rays) of sup(166,) $^{168}$Er and $^{176}$Hf have been measured. The measured widths [GAMMA($^{166}$Er) = 19.7(0.9) keV, GAMMA($^{168}$Er) = 19.4(1.0) keV, and GAMMA($^{176}$Hf) = 27.8(4.3) keV] are in good agreement with theoretical calculations, and suggest that anomalous widths, if they exist, begin at or above Z = 73.

7593 **Theory of structures in the doubly differential cross section for collisional detachment of electrons from $H^-$.** Crawford, O.H. (Oak Ridge National Lab., TN). *Physics Letters [Section] A;* **104**: No. 1, 25-28(6 Aug 1984).

The two groups in the energy distribution of electrons detached from $H^-$ in collision with gases are shown to originate from ejection into l=0 and l>0 states, respectively. The energies of these groups and their behavior with variation of beam energy, target species, and angle are explained.

7594 **$4s^2\ ^1S_0$-$4s4p^1P_1$ transitions in zinclike ions.** Acquista, N.; Reader, J. (National Bureau of Standards, Washington, D.C. 20234). *Journal of the Optical Society of America B: Optical Physics;* **1**: No. 4, 649-651(Aug 1984).

The $4s^2\ ^1S_0$-$4s4p^1P_1$ transitions of 20 zinclike ions from $Ru^{14+}$ to $Du^{36+}$ were observed in a laser-produced plasma with a 10.7-m grazing-incidence spectrograph. Also, new observations were made of the 3d-4f transitions of $Fe^{18+}$. Based on the new wavelengths obtained for these Fe transitions and improved wavelengths recently published for other Fe ions, revised values were determined for the $4s^2\ ^1S_0$-$4s4p^1P_1$ transitions in ten zinclike ions from $Ba^{36+}$ to $W^{44+}$ observed by Reader and Luther [Phys. Rev. Lett. 45, 609-613(1980)] for which a laser-produced spectrum of Fe was used for wavelength calibration.

7595 **Semiclassical and quantum vibrational intensities.** Wardlaw, D.M.; Noid, D.W.; Marcus, R.A. (California Inst. of Tech., Pasadena). *Journal of Physical Chemistry;* **88**: No. 3, 536-547(1984).

The semiclassical theory of infrared vibrational intensities is extended and applied to multidimensional systems. The validity and utility of the semiclassical approach is assessed by comparison with perturbative and exact quantum results for one nonresonant and two resonant model Hamiltonian systems. Approximate mean trajectories are found to provide intensities accurate to within approximately 20% and frequencies accurate to within approximately 1% for almost all transitions studied. More accurate semiclassical results can be obtained by using exact mean trajectories and, for intensities in the nonresonant system, trajectories determined by an improved correspondence rule. The advantages and limitations of the semiclassical method are summarized.

7596 **Excitation of simple atoms by slow magnetic monopoles.** Kroll, N.M.; Drell, S.D.; Ganapathi, V.; Parke, S.J. (Univ. of California--San Diego, LaJolla, CA). pp 295-315 of Monopole '83. Stone, J.L. New York, NY, USA; Plenum Press (1984). (CONF-8310227—).

From Monopole '83 conference; Ann Arbor, MI, USA (6 Oct 1983).

The authors present a theory of excitation of simple atoms by slow moving massive monopoles. Previously presented results for a monopole of Dirac strength on hydrogen and helium are reviewed. The hydrogen theory is extended to include arbitrary integral multiples of the Dirac pole strength. The excitation of helium by double strength poles and by dyons is also discussed. It is concluded that a helium proportional counter is a reliable and effective detector for monopoles of arbitrary strength, and for negatively charged dyons.

7597 **Binding of nuclei to monopoles.** Goebel, C.J. (Univ. of Wisconsin-Madison, WI). pp 333-337 of Monopole '83. Stone, J.L. New York, NY, USA; Plenum Press (1984). (CONF-8310227—).

From Monopole '83 conference; Ann Arbor, MI, USA (6 Oct 1983).

This chapter considers radiative capture as a means for a nucleus to get bound to a monopole. The binding energy is radiated away as a photon emitted by the electric dipole of the transition of the nucleus from a continuum state to the bound state. It is determined that the dipole matrix element is not very sensitive to the short range part of the interaction, and that the big contribution to the radial integral comes from the region of the bound state's turning point. The radiative capture of a proton by a slow monopole is suppressed by the no 0-0 transition rule.

7598 **Molecular symmetry. IV. The coupled perturbed Hartree-Fock method.** Takada, T.; Dupuis, M.; King, H.F. (Lawrence Berkeley Lab., CA). *Journal of Computational Chemistry;* **4**: No. 2, 234-240(1983). Contract AC03-76SF00098.

Symmetry methods employed in the ab initio polyatomic program HONDO are extended to the coupled perturbed Hartree-Fock (CPHF) formalism, a key step in the analytical computation of energy first derivatives for configuration interaction (CI) wave functions, and energy second derivatives for Hartree-Fock (HF) wave functions. One possible computational strategy is to construct Fock-Like matrices for each nuclear coordinate in which the one- and two-electron integrals of the usual Fock matrix are replaced by the integral first derivatives. Skeleton matrices are constructed from the unique blocks of electron-repulsion integral derivatives. The correct matrices are generated by applying a symmetrization operator. The analysis is valid for many wave functions, including closed- or open-shell spin-restricted and spin-unrestricted HF wave functions. To illustrate the method, the computer time required for setting up the coupled perturbed HF equations for eclipsed ethane using D/sub 3h/ symmetry point group and various subgroups of D/sub 3h/ are compared. Computational times are roughly inversely proportional to the order of the point group. 10 references, 1 table.

## 6404 Fluid Physics

7599 **Lognormality of gradients of diffusive scalars in homogeneous, two-dimensional mixing systems.** Kerstein, A.R.; Ashurst, W.T. (Sandia National Laboratories, Livermore, California 94550). *Physics of Fluids;* **27**: No. 12, 2819-2827(Dec 1984).

Kolmogorov's third hypothesis, as extended by Gurvich and Yaglom, is found to be obeyed by a diffusive scalar for a class of homogeneous, two-dimensional mixing models. The mixing models

all involve the advection of fluid by discrete vortices distributed in a square region with periodic boundary conditions. By computer simulation, it is found that the squared gradient of a diffusive scalar so advected is lognormally distributed, obeys the predicted scaling when a spatial smoothing is applied, and exhibits a power-law range in the spatial autocorrelation. In addition, it is found that the scaling property cuts off at the Batchelor length, as predicted by Gibson. Since the mixing models employed do not incorporate the dynamical features of high-Reynolds-number turbulence, these results suggest that scalar lognormality and associated scaling behavior may be more robust or persistent than the scaling laws of the flow field.

7600 **Hybrid asymptotic-finite element method for stiff two-point boundary value problems.** Chin, R.C.Y.; Krasny, R. (Lawrence Livermore National Lab., CA). *SIAM Journal on Scientific and Statistical Computing;* **4**: No. 2, 229-243(Jun 1983). Contract W-7405-ENG-48.

An accurate and efficient numerical method has been developed for a nonlinear stiff second order two-point boundary value problem. The scheme combines asymptotic methods with the usual solution techniques for two-point boundary value problems. A new modification of Newton's method or quasilinearization is used to reduce the nonlinear problem to a sequence of linear problems. The resultant linear problem is solved by patching local solutions at the knots or equivalently by projecting onto an affine subset constructed from asymptotic expansions. In this way, boundary layers are naturally incorporated into the approximation. An adaptive mesh is employed to achieve an error of $O(1/N^2) + O(\sqrt{\varepsilon})$. Here, N is the number of intervals and epsilon $<<$ 1 is the singular perturbation parameter. Numerical computations are presented.

## 6450 High Energy Physics

*REFER ALSO TO CITATION(S) 6450007701, 7705*

## 6451 Particle Interactions And Properties - Experimental

*REFER ALSO TO CITATION(S) 6451007713*

7601 **(ANL-HEP-CP—84-22) SOUDAN 2 nuclear decay experiment. Progress report.** Minnesota; Argonne; Oxford; Rutherford; Tufts Collaboration. (Argonne National Lab., IL (USA)). 29 Jun 1984. Contract W-31-109-ENG-38. 3p. (CONF-840757—8). NTIS, PC A02. File Number DE84016895.

From 22. international conference on high energy physics; Leipzig, German D.R. (19 Jul 1984).

Construction of the experiment cavern on the 27th level of the SOUDAN iron mine in northern Minnesota began early this year and will be complete early in 1985. The first 1200 tons of the detector itself is also under construction in the US and UK; installation will begin in mid 1985. Physics exploitation will begin early in 1986 and the first 1200 ton module will be complete early in 1987. The detector may be expanded to between 3 and 5 such modules in the cavern. The detector is an iron tracking calorimeter (rho = 2) consisting of stacks of corrugated steel sheets each 1.2 mm thick. The corrugations form hexagonal channels 1 m long and 16 mm in diameter. A uniform electric field along these channels is provided by the voltage grading arising from the constant standing current in the Hytrel tubes (rho = 2 x $10^{12}$ Ω cm) that line each channel. The tubes are insulated from the steel by sheets of mylar. Ionization in the gas in the tubes drifts in the uniform field to the end of the tube where it is amplified linearly and detected by a matrix of anode wires and cathode strips. The electronics registers both the drift time and the pulse height of all signals.

7602 **(BNL—35378) Identification of W pairs at the SSC.** Fernandez, E.; Grannis, P.D.; Linn, S.L.; Hauptman, J.M.; Paige, F.E.; Selove, W. (Colorado Univ., Boulder (USA); State Univ. of New York, Stony Brook (USA); Iowa State Univ. of Science and Technology, Ames (USA); Brookhaven National Lab., Upton, NY (USA); Pennsylvania Univ., Philadelphia (USA)). 1984. Contract AC02-76CH00016. 9p. (CONF-8406198—21). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003214.

From Design and utilization of the superconducting super collider summer study; Snowmass, CO, USA (23 Jun 1984).

The background for W pairs at the SSC is analysed. A procedure is developed to obtain a signal/background ratio of order 1/1 for one leptonic and one hadronic decay. 20 references.

7603 **(DESY—84-033) Observation of radiative $e^+e^-$ annihilation into $\mu\mu\gamma$ and $\mu\mu\gamma\gamma$.** Bartel, W.; Becker, L; Bowdery, C.; Cords, D.; Felst, R.; Haidt, D.; Huttunen, J.; Junge, H.; Knies, G.; Krehbiel, H. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Apr 1984. 16p. NTIS (US Sales Only), PC A02/MF A01. File Number DE84752296.

Radiative muon pair production in $e^+e^-$ reactions, $e^+e^- \rightarrow \mu\mu\gamma$ and $e^+e^- \rightarrow \mu\mu\gamma\gamma$, has been studied. Observed events were compared with the QED predictions and good agreement was seen. There was no indication of the production of an excited muon in either final state. From $\mu\mu\gamma$ a limit on the mass and/or coupling constant was obtained. From $\mu\mu\gamma\gamma$ a lower limit on the excited muon mass was obtained to be 22.0GeV(95% CL) if the pair production cross section is pointlike.

7604 **(DESY—84-036) Measurement of exclusive eta' production in $\gamma\gamma$ reactions.** Berger, C.; Deuter, A.; Genzel, H.; Lackas, W.; Pielorz, J.; Raupach, F.; Wagner, W.; Klovning, A.; Lillestoel, E.; Bussey, P.J. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Apr 1984. 13p. NTIS (US Sales Only), PC A02/MF A01. File Number DE84752295.

We observe $\gamma\gamma$->eta' production in the reaction $e^+e^- \rightarrow e^+e^-\pi^+\pi^-\gamma$. We measure the product GAMMAsub($\gamma\gamma$)(eta')B(eta' -> rho$^0\gamma$) to be 1.14+-0.08+-0.11 keV. A first measurement of the $\gamma\gamma$->eta' transition form factor is made for $Q^2$ up to 1 $GeV^2$.

7605 **(DESY—84-039) F meson production from $e^+e^-$ annihilation in the TASSO detector.** Karshon, U. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). May 1984. 12p. (CONF-8403121—10; WIS-PH—14/84). NTIS (US Sales Only), PC A02/MF A01. File Number DE84752298.

From New particle production at high energy meeting: The Recontre de Moriond; La Plagne, France (4 Mar 1984).

Inclusive Dsup(*+-) and Fsup(+-) production have been observed by $e^+e^-$ annihilation at high energies in the final states $D^0\pi$sup(+-) and phi$\pi$sup(+-) respectively. The Dsup(*+-) energy spectrum is hard, peaking near x=0.6, and the Fsup(+-) spectrum is similar. The mass of the Fsup(+-) meson is 1975+-9+-10 MeV and its width is consistent with the mass resolution. The yield of Fsup(+-) production relative to $\mu$ pair production times the phi$\pi$sup(+-) branching ratio is Rsub(F)xB(Fsup(+-)->phi$\pi$sup(+-)) = 0.064+-0.013+-0.019. A preliminary upper limit for the phi3$\pi$ decay mode is Rsub(F)xB(Fsup(+-)->phi$\pi$sup(+-)$\pi^+\pi^-$)<0.023 (90% C.L.)

7606 **(DOE/ER/01195—495) Phi meson production in J/psi decays and determination of the spin and parity of the eta-C(2980).** Spadafora, A.L. (Illinois Univ., Urbana (USA). Dept. of Physics). 1984. Contract AC02-76ER01195. 147p. (COO—1195-495). NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE85000714.

We have studied the production of phi mesons in J/psi decays with the Mark III detector at the SPEAR e+e$^-$ storage ring. General features of inclusive phi production are discussed as well as the observation of several exclusive channels containing phi's. From a sample of 2.7 million J/psi's, we have measured the branching ratio of J/psi → phi eta to be (6.8 +- 0.6 +- 0.9) x $10^{-4}$

and that of J/psi → phi eta' to be (3.7 +- 0.6 +- 0.6) x $10^{-4}$. We also present the first observation of the sequential decay J/psi → γ eta c, eta c → phi phi, and we have measured the product branching ratio to be (1.02 +- 0.25 +- 0.14) x $10^{-4}$. The angular distributions of the final state particles in this decay mode give the first experimental determination that the spin and parity of the eta c are $0^-$. 50 references, 47 figures.

7607 **(DOE/ER/05096—15) High energy physics. Progress report, March 1, 1984-February 28, 1985.** Phillips, G.C.; Roberts, J.B. Jr. (Rice Univ., Houston, TX (USA). Bonner Nuclear Labs.). 25 Oct 1984. Contract AS05-76ER05096. 150p. NTIS, PC A07. File Number DE85003030.

A second run of E-609, FNAL, was carried out. Monte Carlo studies emloying a Feynman-Field model were shown to give results dependent on the method used to approximate energy-momentum conservation, while a Field-Fox-Wolfram model fits the E-609 data and lends indirect evidence of gluon bremsstrahlung effects. Comparison of π and p induced large p/sub t/ di-jet events revealed a new, unique event structure with little or no energy along the π-beam direction when compared to the p-beam events. New data were obtained for p-Nuclear collisions at 400 GeV for H, He, Be, C, Al, Cu, Sn, and $Pb^0$, and analysis has commenced. The 200 MeV polarimeter, designed, built, calibrated, and installed on the AGS by our group was successfully and reliably used in the acceleration of AGS polarized protons. Participation in the beam tune up studies helped to attain 40% polarization at 16.5 GeV/c and allowed start up of the pp elastic scattering experiment E-782 (AGS). E-704 received second stage approval with an agreement signed by the director of FNAL. The experiment is scheduled to start January 1987, so that detailed design of equipment was commenced and the need for equipment funds became acute. In addition, progress was made in theoretical physics and in instrumentation. During the year Dr. Paul Stevenson joined our group and started new, basic research in elementary particle theory in the areas of quantum field theory and perturbative QCD. Progress in instrumentation made during the year included a start on MWPC design for E-704 equipment for which Rice is committed. New electronic design studies included a new MWPC readout system and a new I/O Processor.

7608 **(IFVE-OEF—83-119) A-dependence of hadron pair production with high Psub(T).** Abramov, V.V.; Baldin, V.Yu.; Buzulutskov, A.F. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1983. 7p. NTIS (US Sales Only), PC A02/MF A01. File Number DE84703229.

The A-dependence of charged hadron pair production has been measured. The approximation of the invariant cross-section by the function Asup(αsub(2)) has given the value $\alpha_2$ approximately 1 in the whole range 0.46 <= Psub(T) 2.27 GeV/c. The dependence of $\alpha_2$ on the pair species has been observed.

7609 (INIS-SU—228, pp 209-215) **Polarization experiments in π-meson production in the range of the first baryon resonances.** Karnaukhov, I.M. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1982. (In Russian). NTIS (US Sales Only), PC A13/MF A01. File Number TI84780397. (CONF-8106173—).

From 5. seminar on electromagnetic interactions of nuclei at low and medium energies; Moscow, USSR (15 Jun 1981).

The results of investigations into polarization parameters in γN→πN reactions for single photoproduction of pions in the energy range up to 1 GeV obtained for recent 5-6 years are described. Main contribution to the cross section of single photoproduction of pions is made by the mechanism of nucleon resonance excitation in this energy range. That is why γN→πN reactions are an important source of data on properties of these resonances and on electro-magnetic coupling constants. Besides, valuable data on general properties of electromagnetic hadron currents, its isotopic structure and on T-invariance may be obtained in the investigated reactions. Solution of these problems is associated with single-valued reproduction of amplitudes of γN→πN processes from the experimental data. Data obtained from single- and double-polarization experiments are tabulated. Energy dependences of polarization parameters in the $\gamma p \to n\pi^+$, $\gamma p \to \pi^0 p$, $\gamma n \to \pi^- p$, $\gamma p \to p\pi^0$ reactions are given for illustration of experimental situation. It is revealed that data obtained at different laboratories agree well. Amplitudes of radiation disintegration for $P_{33}(1232)$, $P_{11}(1470)$, (1510), (1535) determined from the experimental data and calculated by the quark models are given.

7610 (Juel-Spez—255, pp 60-61) **Search for the two photon decay of light penetrating bosons with the use of a rotatable detector arrangement.** Bechteler, H.; Faissner, H.; Yogeshwar, R.; Ermer, W.; Koch, H.R.; Schult, O.W.B.; Seyfarth, H. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

7611 **(KEK—82-8) Proceedings of the 4th workshop on the mass of the electron neutrino.** Yasumi, Shinjiro (ed.). (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)). Sep 1982. 93p. (CONF-8203187—). NTIS (US Sales Only), PC A05/MF A01. File Number DE85780011.

From 4. workshop on the mass of the electron neutrino; Oho, Ibaraki, Japan (27 Mar 1982).

Separate entries were made in the data base for the papers presented. (WHK)

7612 **(KFK—3758) Search for new particles at PETRA.** Fluegge, G. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Kernphysik). Jun 1984. 21p. (CONF-840280—10). NTIS (US Sales Only), PC A02/MF A01. File Number DE84752338.

From Recontre de Moriond meeting on electro weal interactions and unified theories; La Plaque, France (26 Feb 1984).

Latest results from PETRA since autumn last year are presented. New experimental limits on narrow resonances, composite bosons and supersymmetric particles are discussed. A peculiar hadronic event with two isolated muons and high invariant leptonic and hadronic masses is shown.

7613 **(LBL—18424) Quark fragmentation in $e^+e^-$ annihilation.** Barbaro-Galtieri, A. (Lawrence Berkeley Lab., CA (USA)). Sep 1984. Contract AC03-76SF00098. 37p. (CONF-8406183—6). NTIS, PC A03. File Number DE85000597.

From 15. international symposium on multiparticle dynamics; Lund, Sweden (11 Jun 1984).

Experimental data that provide information on parton fragmentation are reviewed. The data are compared with the internal fragmentation (IF) model, color string fragmentation (LUND) model, QCD-cluster models, and Gottschalk model. The LUND model is used most often. The general features of the data are well described by all models. Differences between independent fragmentation and string fragmentation appear clearly in detailed studies of three-jet events. The string fragmentation model fits the data better. 47 references. (LEW)

7614 **(MPI-PAE/Exp.El.—128) Study of transverse momenta of charged hadrons produced in νp and anti νp charged current interactions.** Jones, G.T.; Kennedy, B.W.; Middleton, R.P.; O'Neale, S.W.; Cooper, A.M.; Grant, A.; Klein, H.; Mittendorfer, J.; Morrison, D.R.O.; Parker, A. (Max-Planck-Institut fuer Physik und Astrophysik, Muenchen (Germany, F.R.). Werner-Heisenberg-Inst. fuer Physik). May 1984. 25p. NTIS (US Sales Only), PC A02/MF A01. File Number DE84752304.

Data from neutrino and antineutrino hydrogen experiment with BEBC are used to investigate transverse properties of the produced charged hadrons. Measurements are presented on average transverse momenta of charged pions as functions of Feynman-x and the hadronic mass, on the transverse momentum flow within an event and on jet-related quantities. The main features of the data are well described by the LUND model. The data favour a version of the model in which soft gluon effects are included and the primordial transverse momentum of the quarks in the proton is small. Effects from 1st order QCD (hard gluon emission) are negligible.

7615 **(RL—84-001) Particle physics experiments 1983.** Stuart, G.W. (Rutherford Appleton Lab., Chilton (UK)). 1983. 255p. NTIS (US Sales Only), PC A12/MF A01. File Number DE85700134.

The report describes work carried out in 1983 on experiments approved by the Particle Physics Experiments Selection Panel. The contents consist of unedited contributions from each experiment.

7616 **(SLAC-PUB—3421) Recent particle searches at PEP.** Messner, R.L. (Stanford Linear Accelerator Center, CA (USA)). Aug 1984. Contract AC03-76SF00515. 13p. (CONF-840463—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85002719.

From 6. annual energy seminar; Erie, PA, USA (3 Apr 1984).

Particle searches discussed include: the TPC search for charge 2/3 and 1/3 particles, $e^+e^- \rightarrow \gamma\gamma$, and supersymmetry searches for electrinos and photinos. (LEW)

7617 **(SLAC-PUB—3434) Recent progress in electron scattering at SLAC.** Arnold, R.G. (American Univ., Washington, DC; Stanford Linear Accelerator Center, CA (USA)). Sep 1984. Contract AC03-76SF00515. 9p. (CONF-840789—5). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85002718.

From International conference on particles and nuclei; Heidelberg, F.R. Germany (30 Jul 1984).

A new experiment on ep elastic scattering at large momentum transfer, Experiment E136, has recently completed data taking. A new measurement of deep inelastic electron scattering from nuclear targets, Experiment E139, has been completed and preliminary results are available. A new program of experiments has begun, called Nuclear Physics at SLAC (NPAS), that will use a new injector on the SLAC linac to provide high intensity beams in the energy range from 0.5 to 6 GeV.

7618 **(SLAC-PUB—3456) Signals of new W's and Z's.** Haber, H.E. (California Univ., Santa Cruz (USA). Dept. of Physics; Stanford Linear Accelerator Center, CA (USA)). Sep 1984. Contract AC03-76SF00515. 20p. (CONF-8406198—16). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85002606.

From Design and utilization of the superconducting super collider summer study; Snowmass, CO, USA (23 Jun 1984).

If new heavy charged and/or neutral gauge bosons exist with masses below 5 to 10 TeV, they can be observed at the SSC. In this report, we summarize the work of the New W/Z Physics Subgroup. The expected properties of new heavy gauge bosons (such as new W's and Z's or horizontal gauge bosons) are summarized. We then discuss various signatures of these new gauge bosons and their implications for detector designers. Suggestions for future work are indicated. 60 references.

7619 **Search for B/sup /→B+γ in Y"" decays and the B/sup /-B mass difference.** Schamberger, R.D.; Horstkotte, J.E.; Klopfenstein, C.; Lee-Franzini, J.; Sivertz, M.; Spencer, L.J.; Franzini, P.; Son, D.; Tuts, P.M.; Youssef, S.; Zhao, T.; Herb, S.W.; Han, K.; Imlay, R.; Levman, G.; Metcalf, W.; Sreedhar, V.; Dietl, H.; Eigen, G.; Lorenz, E.; Mageras, G.; Pauss, F.; Vogel, H. (The State University of New York at Stony Brook, Stony Brook, New York 11794). *Physical Review* [*Section*] *D: Particles and Fields;* **30**: No. 9, 1985-1987(1 Nov 1984).

The CUSB detector at the Cornell Electron Storage Ring is used to measure the inclusive photon spectrum at the Y"" peak at 10.58 GeV. In roughly-equal50 000 Y"" decays, we do not observe any photon signal from B(→B+γ decays for 20<E/sub γ/<140 MeV. We obtain an upper limit on the branching ratio for Y""→ monochromatic γ+ hadrons of 6% to 9% at 90% confidence level. From the lack of a photon signal and the observed width of the Y"" we deduce that the reconstructed b-flavored mesons from Y"" are most likely the pseudoscalar B mesons and that the M(B()-M(B)> or =30 MeV.

7620 **Leptonic branching ratio of the Y(2S).** Hass, P.; Jensen, T.; Kagan, H.; Kass, R.; Behrends, S.; Chadwick, K.; Chauveau, J.; Gentile, T.; Guida, J.M.; Guida, J.A.; Melissinos, A.C.; Olsen, S.L.; Parkhurst, G.; Peterson, D.; Poling, R.; Rosenfeld, C.; Thorndike, E.H.; Tipton, P.; Besson, D.; Green, J.; Namjoshi, R.; Sannes, F.; Skubic, P.; Snyder, A.; Stone, R.; Chen, A.; Goldberg, M.; Hejazifar, M.E.; Horwitz, N.; Jawahery, A.; Lipari, P.; Moneti, G.C.; Trahern, C.G.; van Hecke, H.; Alam, M.S.; Csorna, S.E.; Garren, L.; Mestayer, M.D.; Panvini, R.S.; Yi, X.; Avery, P.; Bebek, C.; Berkelman, K.; Cassel, D.G.; DeWire, J.W.; Ehrlich, R.; Ferguson, T.; Galik, R.; Gilchriese, M.G.D.; Gittelman, B.; Halling, M.; Hartill, D.L.; Holzner, S.; Ito, M.; Kandaswamy, J.; Kreinick, D.L.; Kubota, Y.; Mistry, N.B.; Morrow, F.; Nordberg, E.; Ogg, M.; Read, K.; Silverman, A.; Stein, P.C.; Stone, S.; Wilcke, R.; Kezun, X.; Sadoff, A.J.; Giles, R.; Hassard, J.; Hempstead, M.; Kinoshita, K.; MacKay, W.W.; Pipkin, F.M.; Wilson, R. (Ohio State University, Columbus, Ohio 43210). *Physical Review* [*Section*] *D: Particles and Fields;* **30**: No. 9, 1996-1997(1 Nov 1984).

Using the CLEO magnetic detector at the Cornell Electron Storage Ring, we find $B(Y(2S)\rightarrow\mu^+\mu^-) = 0.018 +- 0.008$ (statistical) +- 0.005 (systematic) and $B(Y(2S)\rightarrow tau^+ tau^-) = 0.017 +- 0.015 +- 0.006$. .AE

7621 **D/sub S/S, D/sub L/L, D/sub S/L, D/sub L/S, and P for pp→pp at 600 to 800 MeV.** Hollas, C.L.; Cremans, D.J.; McNaughton, K.H.; Riley, P.J.; Rodebaugh, R.F.; Xu, S.; Bonner, B.E.; McNaughton, M.W.; Ohnuma, H.; van Dyck, O.B.; Tsu-hsun, a.S.; Turpin, S.E.; Aas, B.; Weston, G.S. (University of Texas at Austin, Austin, Texas 78712). *Physical Review* [*Section*] *C: Nuclear Physics;* **30**: No. 4, 1251-1255(Oct 1984).

We have measured the spin parameters D/sub S/S, D/sub L/S, D/sub S/L, D/sub L/L (K/sub S/S, K/sub L/S, K/sub S/L, K/sub L/L), and P from 18° to 134° c.m. for pp→pp at 597, 647, 699, 750, and 800 MeV. (We also include four D/sub N/N points that cross-check previous data.) The pp elastic phase shifts are now overdetermined near 597, 647, and 800 MeV and well determined near 699 and 750 MeV. The data are in satisfactory agreement with preexisting phase shift analyses and show no new energy dependence.

## 6452 Particle Interactions And Properties - Theoretical

*REFER ALSO TO CITATION(S) 6452007618, 7661, 7663, 7689, 7696, 7704, 7863*

7622 **(DESY—84-035) Evidence for the nonabelian structure of QCD from panti p collider data.** Furmanski, W.; Kowalski, H. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Apr 1984. 12p. NTIS (US Sales Only), PC A02/MF A01. File Number DE84752299.

We analyse in detail the QCD predictions for the shape of the single inclusive jet psub(T) distribution measured at the panti p collider. The measured shape cannot be described without the three gluon vertex contribution to parton-parton scattering.

7623 **(IC—83/156) Inseparability of colours through dynamical breaking of SUsub(C)(3).** Werle, J. (International Centre for Theoretical Physics, Trieste (Italy)). Sep 1983. 10p. NTIS (US Sales Only), PC A02/MF A01. File Number DE84703225.

A class of feasible quark field models based on the assumption that the quarks are the only carriers of colours is discussed. The forces between quarks are described by local but non-linear interaction between quark fields. Such models are much closer than QCD to the - so far very successful - naive quark model with colours. It is shown that inseparability and localization of colours, which are two basic conditions of quark confinement, are of dynamical nature. In particular, inseparability is simply incompatible with rigorous SUsub(C)(3) invariance. Therefore, explicit dynamical SUsub(C)(3) breaking is proposed in such a form that makes

only the white currents strictly conserved. The resulting field equations imply manifest inseparability of colours.

7624 **(IC—83/206) Radiative Dalitz decays of pseudoscalar mesons.** Pramudita, A. (International Centre for Theoretical Physics, Trieste (Italy)). Oct 1983. 9p. NTIS (US Sales Only), PC A02/MF A01. File Number DE84703224.

The radiative Dalitz decays of $\pi^0$, eta, eta' and Ksub(L) into a photon and a lepton or pion pair are examined. The leptonic decays agree with two-photon amplitude and vector dominance model, but the non-leptonic decays do not. A simple model for the latter is proposed.

7625 **(IFVE-ONF—83-45) Neutrino counting in colliding $e^+e^-$ beams.** Gnedov, Yu.A.; Tikhonin, F.F. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1983. 5p. NTIS (US Sales Only), PC A02/MF A01. File Number DE84703219.

The cross section for the $e^+e^- \rightarrow \nu_1\nu$sub(i)$\nu$sub(i)tilde$\gamma$ process has been calculated without any approximations made. At high energies this expression is rather useful for integration over all azimuthal emission angles of photon. The terms earlier rejected have been evaluated. Their contribution is indeed negligible for the purposes of the experiment under dicussion. At low energies this expression may turn out to be useful for astrophysical application.

7626 **(IFVE-OTF—83-144) Multiple hadron production in three-jet events.** Dzhaparidze, G.Sh. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1983. 12p. NTIS (US Sales Only), PC A02/MF A01. File Number DE84703220.

Hadrons multiplicity in three et-events in $e^{+-}$-annihilation has been considered. It is shown that the equalitative agreement with the QCD predictions is observed already at available energies.

7627 **(INFN/AE—83-2) Synchrotron radiation from the low-beta quadrupoles scattered back toward the short insertion of LEP.** Del Fabbro, R. (Istituto Nazionale di Fisica Nucleare, Pisa (Italy)). 1983. 15p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700129.

By Monte carlo calculation the synchrotron radiation produced by the LEP beam in the low-beta quadrupoles is evaluated. The radiation is simulated to scatter back along the beam pipe toward the short insertion of LEP in the mini-beta version. The back photcn flux reaching the experimental insertion is calculated and the corresponding energy and delay time spectra are given as well as the azimuthal distribution. It results that be back scattered radiation from the low-beta quadrupoles don't appear to be dangerous, mainly because the bulk of this radiation is delayed more than 200 nsec with respect to the crossing time. On the contrary the back radiation coming from the quadrupoles upstream the short insertion could be a more serious source of background.

7628 **(INIS-mf—9125) Analytically solvable multichannel Schroedinger model for hadron spectroscopy.** Beveren, E. van; Dullemond, C.; Rijken, T.A. (Katholieke Univ. Nijmegen (Netherlands). Inst. voor Theoretische Fysica); Rupp, G. (Bielefeld Univ. (Germany, F.R.). Zentrum fuer Interdisziplinaere Forschung). (Geological Survey of Japan, Yatabe, Ibaraki (Japan)). [nd]. 12p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85780126.

In this note a potential model based on the coupled-channel Schroedinger formalism will be reviewed, that, when applied to meson spectroscopy gives a simultaneous description of both the confinement and the decay sector. The model is formulated in such a way that the coupled-channel problem can be solved analytically, yielding an explicit expression for the S-matrix, which is either exact or a good approximation depending on the chosen interactions. In section II a two-channel toy model is studied in order to demonstrate the behaviour of resonances and bound states for such like systems. Section III then deals with a multichannel generalization of the model. In section IV the application to meson spectroscopy is shown and some results for two different versions of the model are presented.

7629 **(INIS-SU—228, pp 216-228) Pion photoproductiop on nucleons in the energy range of $\Delta_{33}$(1232) isobar excitation.** Lebedev, A.I.; Mangazeev, B.V. (AN SSSR, Moscow. Fizicheskij Inst.). 1982. (In Russian). NTIS (US Sales Only), PC A13/MF A01. File Number TI84780397. (CONF-8106173—).

From 5. seminar on electromagnetic interactions of nuclei at low and medium energies; Moscow, USSR (15 Jun 1981).

Experimental data on study into reactions of single $\pi$-meson photoproduction on nucleons: $\gamma+p\rightarrow\pi^++n$, $\gamma+p\rightarrow\pi^0+p$, $\gamma+n\rightarrow\pi^-+p$, $\gamma+n\rightarrow\pi^0+n$ in the energy range of photon excitation from the threshold energy up to Esub($\gamma$) approximately equal to 500 MeV are reviewed. Data on amplitudes of pion photoproduction is obtained from the present experimental data. Two approaches used for analysis of experimental data on the observed $\gamma N\rightarrow\pi N$ processes: phenomenological based on general principles of relativistic quantum theory of the field and dynamical using different dynamical interactions of particles are presented. Results of the conducted energy-dependent and energy-independent multipole analyses of pion photoproduction amplitudes are given within the frames of the phenomenological approach. Threshold values of s-wave amplitude of $\gamma+p\rightarrow\pi^0+p$ process are given in a table. Graphically presented experimental values of ReE$_0$ReEsub(1+), ReMsub(1-), ReMsub(1+) amplitudes in a concentrated form bear total data on the investigated processes. Parameters of $\Delta_{33}$(1232)-isobar and photon width GITAsub($\gamma$), the values of which noticeably exceed those obtained within the frames of quark model are determined. Amplitudes of the isobar photoexcitation in the quark model are considered.

7630 **(INS—463) Fundamental theory of composite particles and fields.** Terazawa, Hidezumi. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Feb 1983. 11p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700130.

A fundamental theory of composite particles and fields is proposed. It effectively reproduces not only gauge theories for the strong and electroweak forces of leptons and quarks but general relativity for gravity at low energies and predicts the relation, $e^2 = 16\pi GM^2$ (where e, G and M are the gauge coupling constant, the Newtonian gravitational constant and the subquark mass), which indicates M asymptotically equals $10^{18}$GeV.

7631 **(INS—465) Deconfining and chiral phase transitions in quantum chromodynamics at finite temperature.** Banks, T.; Ukawa, A. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Mar 1983. 23p. NTIS (US Sales Only), PC A02/MF A01. File Number DE84703226.

We give further arguments to support the claim of Svetitsky and Yaffe that the finite temperature transition in 4 dimensional SU(N) gauge theories is in the universality class of 3 dimensional z sub(N) spin models. We show that this implies a smoothing out of the transition when quarks are added to the system as long as N not equal 3. For N = 3 the pure gauge transition is expected to be first order and will be smoothed by quarks only if the quark contribution to the internal energy is larger than the latent heat of transition.

7632 **(ITEF—143(1983)) Lifetime of $K^+$ meson bubble in a nuclear matter and atomic nuclei.** Koldaev, M.V.; Koldaveva, O.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1983. 18p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE84703227.

The problem of lifetime of hadron localized states in nuclear matter is considered on the example of hadron bubbles. "Hadron bubble" is a region with nucleon density equal to zero in which hadron field is localized. Subbarrier "collapse" with adiabatic ejection of hadron level is shown to be the mechanism of bubble decay near the boundary of stability. Estimation of lifetime of $K^+$-meson bubbles is given. Estimation of lifetime associated with hadron escape from the nucleus is made for bubbles stable in nuclear matter.

7633 **(JINR—E-2-83-863) Bag-model matrix elements of the parity-violating weak hamiltonian for charmed baryons.** Ebert, D.; Kallies, W. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1983. 10p. NTIS (US Sales Only), PC A02/MF A01. File Number DE84703221.

Baryon matrix elements of the parity-violating part of the charmchanging weak Hamiltonian might be significant and comparable with those of the parity-conserving one due to large symmetry breaking. Expression for these new matrix elements by using the MIT-bag model are derived and their implications on earlier calculations of nonleptonic charmed-baryon decays are estimated.

7634 **(JINR—R-1-83-832) Charmed particle decay and selection rules for elementary particles.** Nguen Mong Zao. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1983. 15p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE84703222.

Selection rules for elementary particles taking into account intrinsic characteristics of quarks, leptons and spurions are used for the analysis of experimental data on the decays of charmed particles (D and F mesons, Asub(c)sup(+) and Σsub(c)sup(+) baryons). It is shown that experimental data are well described by these selection rules. A physical meaning of the Gell-Mann-Feynmann selection rules is discussed. The selection rules ΔQ=ΔS and ' ΔS ' <= 1 have one physical meaning A qualitative explanation of breaking the selection rules ΔI=1/2 in the hadron decay of strange particles and the rules ΔQ=ΔS in the decays of charmed particles is given.

7635 **(JINR—R-2-83-508) Vector-meson contribution to the isovector electric nucleon form factor.** Krupa, D.; Dubnichka, S.; Kundrat, V.; Meshcheryakov, V.A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1983. 16p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE84703223.

The analysis of space-like data of the isovector part of the electric nucleon form factor Gsub(E)sup(V)(t) is carried out by means of the new analytic parameterization. The analysis confirms the importance of the short logarithmic cut on the second sheet just below the ππ threshold coming from the nucleon exchange in the πN scattering amplitude. It also favoures the existence of the rho meson pole on the second Riemann sheet and of the rho' and rho'' meson poles on the third Riemann sheet in t-variable. The analysis gives for the isovector electric nucleon radius value Rsub(E)sup(V)=0.87 (fm) and estimates the corresponding coupling constants.

7636 (Juel-Spez—255, pp 89) **Deformable chiral bag.** Wambach, J.; Ma, Z.Y. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

7637 (Juel-Spez—255, pp 91) **Quantum variational approach to the chiral bag.** Urbano, J.N.; Goeke, K. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

7638 (Juel-Spez—255, pp 91-92) **Effect of the quantum fluctuations of the pion field on the chiral bag energy.** Urbano, J.N.; Goeke, K. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

7639 (Juel-Spez—255, pp 92-93) **Hedgehog solution.** Urbano, J.N.; Goeke, K. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

7640 (KEK—82-1, pp 511-559) **2 GAMMA collisions.** Matsuda, Satoshi (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)). May 1982. NTIS (US Sales Only), PC A16/MF A01. File Number TI85780079. (CONF-8111151—).

From 2. workshop on detectors for TRISTAN; Tsukuba, Japan (6 Nov 1981).

Topics of physics encountered in 2γ reactions are reviewed for TRISTAN research. Emphasis is placed on the theoretical aspects of the 2γ physics.

7641 (KEK—82-1, pp 186-210) **Monte Carlo study of the $e^+e^-$ interactions.** Abe, K. (Tohoku Univ., Sendai (Japan)); Ogawa, K.; Ishii, T.; Egawa, K.; Takasaki, F. May 1982. NTIS (US Sales Only), PC A16/MF A01. File Number TI85780079. (CONF-8111151—).

From 2. workshop on detectors for TRISTAN; Tsukuba, Japan (6 Nov 1981).

Some processes in the electron-positron interaction in the TRISTAN energy range were studied using the QCD Monte Carlo program written by Ali et al. The processes which were studied are; electron + positron → one photon → QQ(bar), QQ(bar)g, QQ(bar)gg, where Q = u, d, s, c, b Fquarks and g is a gluon; electron + positron → one photon → tt(bar) → X, where X = three gluons, weak decay products, Higgs + one photon, and two gluons + one photon; electron + positron → one photon → heavy lepton pair; two photon processes. The general properties of final states in QCD jets are displayed, which include single particle spectra, multiplicity, sphericity, spherocity, and thrust distribution. Based on the analysis, several remarks are made. It is very hard to find the D peak in the invariant mass sperctra for the momentum resolution of 0.3 % of the momenta. One-photon processes can be well separated from two-photon processes. Electron can be identified with a shower counter. The measurement of the leading kaon momentum spectra may be better for the study of t-quark decay mode. Energy resolution should be better than 10 % of $\sqrt{E}$ if it is necessary to see the photon peak corresponding to the Higgs + photon process in the inclusive photon spectrum. Hadron calorimeter makes the one photon peak in a visible energy spectrum narrower, and improves the one- and two-photon process separation.

7642 (KEK—82-2, pp 68-80) **Higher order effects in electroweak theory 1981-12 (KEK).** Aoki, Ken-ichi (Kyoto Univ. (Japan). Faculty of Science). May 1982. (In Japanese). NTIS (US Sales Only), PC A06/MF A01. File Number TI85780077. (CONF-8112107—).

From Meeting on phenomenology of gauge theory; Oho, Ibaraki, Japan (7 Dec 1981).

This is a brief report on the higher order or loop effects in electroweak theory. The discussion is based on the Weinberg Salam model and QCD. The loop correction to weak interaction is described. The renormalization conditions were applied to physical parameters, α(QED), M(W) and M(Z). It is expected to obtain experimentally the values of M(W) and M(Z) with the accuracy of 0.1 percent. In this scheme, the parameters were fixed loop by loop. The correction was evaluated along the present on-shell scheme. The general estimation of the order of correction was performed. The evaluation of the size of terms in one-loop correction was made. The examples of one loop analysis are presented. The leading logarithmic correction such as $\alpha \ln(m^2 q^2/M^2)$ is discussed. The system was described by H(eff) with the local operator O(i), in which the propagator of heavy particles was contracted. The effective interaction was obtained as C(i) $(q^2)$ O(i), where C(i)$(q^2)$ satisfies a proper equation of a renormalization group. As the practical examples, μ-decay, charged current and neutral current were studied. The correction to electron neutral current and the shift of M(W) and M(Z) were numerically obtained. Comments on quark mass and the uncertainty of $\sin^2$(theta) from the νN reaction are presented.

7643 (KEK—82-2, pp 81-86) **Hard Bremsstrahlung effects in purely leptonic weak processes.** Hioki, Yoshio (Kyoto Univ. (Japan). Research Inst. for Fundamental Physics). May 1982. NTIS (US Sales Only), PC A06/MF A01. File Number TI85780077. (CONF-8112107—).

From Meeting on phenomenology of gauge theory; Oho, Ibaraki, Japan (7 Dec 1981).

The hard bremsstrahlung effects in purely leptonic weak processes were studied on the basis of the Weinberg-Salam theory. A small amount of mass was given to a photon. The amplitudes of the leptonic weak processes were obtained. The effects of soft photon emission were calculated to remove the IR divergence. The cross-sections of the processes were estimated from the UV and the IR finite amplitudes. The cross-sections at large photon energy were also estimated. By the Monte-Carlo method, the values of radiative correction were evaluated.

7644 (KEK—82-2, pp 40-47) **Direct photon as a probe of the color symmetry.** Katuya, Mituaki (Shizuoka Women's Univ. (Japan)). May 1982. NTIS (US Sales Only), PC A06/MF A01. File Number TI85780077. (CONF-8112107—).

From Meeting on phenomenology of gauge theory; Oho, Ibaraki, Japan (7 Dec 1981).

High energy direct photon production $H_1H_2 \rightarrow \gamma X$ is discussed on the basis of the gauge theory of the minimal SU(2)sub( l) x U(1) x SU(3)sub(c) It is shown that the experiments on the direct photon production will provide a crucial test of the broken color symmetry theory.

7645 (KEK—82-2, pp 32-36) **Quark and diquark jets.** Noda, Hujio (Ibaraki Univ., Mito (Japan). Dept. of Physics). May 1982. NTIS (US Sales Only), PC A06/MF A01. File Number TI85780077. (CONF-8112107—).

From Meeting on phenomenology of gauge theory; Oho, Ibaraki, Japan (7 Dec 1981).

In this paper, baryon and antibaryon production in $e^+e^-$ annihilation and the target fragmentation in $\nu$(anti-$\nu$)p interaction in terms of a quark and diquark cascade model are discussed. The conventional idea of the quark cascade model is based on a repeated quark decay $q \rightarrow$ meson (M) + q with a sharing of the longitudinal momentum of the original quark by the resulting q and M, and this model was modified so as to include baryon and antibaryon production in quark jet. The three flavors (u, d and s) were included in the model. The model was compared with the data of $e^+e^-$ annihilation and $\nu$(anti-$\nu$)p interaction. The production of baryon and antibaryon in quark jet was studied. Next, the target fragmentation in $\nu$(anti-$\nu$)p interaction was investigated. The model was not able to explain the experiment, and the colored diquark jet uu was introduced. It is concluded that there are independent two-quark mode and collective mode on the side of the target.

7646 (KEK—82-2, pp 87-98) **Topponium spectroscopy.** Kaburagi, M.; Kawaguchi, M.; Morii, T. (Kobe Univ. (Japan). Coll. of Liberal Arts); Morishita, J.; Oka, M. May 1982. (In Japanese). NTIS (US Sales Only), PC A06/MF A01. File Number TI85780077. (CONF-8112107—).

From Meeting on phenomenology of gauge theory; Oho, Ibaraki, Japan (7 Dec 1981).

It is hard to predict something on the t-anti-t system. In this paper, the problems concerning the t-anti-t system are described. The considered potentials were the power law (PL) potential and the Cornell group potential (LCBF0). The relativistic effect in the potentials becomes remarkable in the short range. The effect was calculated for the linear and Coulomb potentials with the Breit-Fermi term (LCBF1 and LCBF2). The binding energy in PL and LCBF0 was estimated in relation to quark mass. The difference between the ground level and the first excited level shows the different features of Coulomb force and others. The decay width of annihilation was estimated. The results of PL were different from those of LCBF0. The main reason of difference is the difference of potentials in the short range. The R(peak) was calculated for both PL and LCBF0. From the calculated spectrum at M(Q) = 28.558 GeV, it was found that the detection of weak decay was hard in LCBF0. The sharp width of the excited levels of the t-anti-t system is expected.

7647 (KEK—82-5, pp 46-63) **Polarization phenomena of nuclear force and weak interaction.** Konuma, Michitsugu (Kyoto Univ. (Japan). Research Inst. for Fundamental Physics). Jul 1982. (In Japanese). NTIS (US Sales Only), PC A05/MF A01. File Number TI85780078. (CONF-8009333—).

From 2. workshop on two nucleon system; Oho, Ibaraki, Japan (19 Sep 1980).

As one of the projects at the National Laboratory of High Energy Physics (KEK), the measurement of parity non-conservation component in nuclear force was proposed. The theoretical survey of this proposal is reported. The non-relativistic parity non-conserving potential between nucleons can be obtained from the interaction between a quark and a gauge boson. The wave function of a nucleus, which includes the inverse components of the parity, can be written. A practical experiment was designed. The mixing of the inverse components and the interference of an inverse component in the 1042 keV and 1081 keV levels of $F^{18}$ may produce the parity non-conservation. The processes which suggest the existence of parity non-conservation were studied. The processes are the circular polarization of gamma-ray emitted from a nucleus, the angular distribution of gamma-ray emitted from polarized nuclei, the collision of the proton beam with helicity of plus and minus on other nuclei, the spin rotation of neutrons, and the alpha decay of the parity non-conservation. The preliminary results of the experiment on the effects of parity non-conservation in the collision process of polarized proton beam have been reported, and the theoretical analyses were performed. The violation of parity conservation in large momentum collision is discussed. The comparison of the theoretical results with the experimental ones is presented.

7648 (RRK—83-4) **General classical solutions of the complex Grassmannian and CP sub(N-1) sigma models.** Sasaki, Ryu. (Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics). May 1983. 11p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700131.

General classical solutions are constructed for the complex Grassmannian non-linear sigma models in two euclidean dimensions in terms of holomorphic functions. The Grassmannian sigma models are a simple generalization of the well known CP sup(N-1) model in two dimensions and they share various interesting properties; existence of (anti-) instantons, an infinite number of conserved quantities and complete integrability.

7649 **Neutrino-mass limits from $K^+ \rightarrow \pi^+ \nu$nu-bar decay.** Deshpande, N.G.; Eilam, G. (Institute of Theoretical Science, University of Oregon, Eugene, Oregon 97403). *Physical Review Letters;* **53**: No. 24, 2289-2291(10 Dec 1984).

The present limit on the mass of the tau neutrino (mtau$<$143 MeV), obtained from tau decay, may be lowered significantly from a study of the pion spectrum in $K^+ \rightarrow \pi^+ \nu$nu-bar. We show that if m/sub nutau/$>$ or $\approx$50 MeV then the pion spectrum differs significantly from its value when all neutrinos are massless. Our results are also applicable to any new massive neutrino with 50$<$ or $\approx$mh-italic$<$ or $\approx$150 MeV.

7650 **New relativistic generalization of the Heisenberg commutation relations.** Bohm, A.; Loewe, M.; Magnollay, P.; Tarlini, M.; Aldinger, R.R.; Kielanowski, P. (Center for Particle Theory, The University of Texas at Austin, Austin, Texas 78712). *Physical Review Letters;* **53**: No. 24, 2292-2295(10 Dec 1984).

A relativistic generalization of the Heisenberg commutation relations is suggested which is different from the conventional ones used for the intrinsic coordinates and momenta in the relativistic oscillator model and the relativistic string. This new quantum relativistic oscillator model is determined by the requirement that it gives a unified description of relativistic vibrations and rotations and contracts in the nonrelativistic limit $c^{-1} \rightarrow 0$ into the usual nonrelativistic harmonic oscillator.

7651 **Sp/sub L/(6) x U/sub $\gamma$/(1) extension of the electroweak theory.** Kuo, T.K.; Nakagawa, N. (Department of Physics, Purdue University, West Lafayette, Indiana 47907). *Physical Review* [*Section*] *D: Particles and Fields;* **30**: No. 9, 2011-2014(1 Nov 1984).

The generation structure of quarks and leptons is incorporated with the electroweak theory in an Sp/sub L/(6) x U/sub Y/(1) model. In this model, the first-generation fermions are naturally light because their masses are generated only as two-loop correc-

tions. Also the inequality m/sub u/<m/sub d/ is related to m/sub t/>m/sub b/.

7652 **B->anti F+X decay and pseudoscalar decay constants of explicitly flavored heavy mesons.** Suzuki, M. (Lawrence Berkeley Lab., CA). *Physics Letters, [Section] B;* **142**: No. 3, 207-211(19 Jul 1984).

If the current theoretical pictures of explicitly flavored heavy mesons are quantitatively correct, we expect that the branching ratio of B -> anti F+X (anything) may be 6 percent even in a conservative estimate. Accurate measurement of this branching ratio will determine the value of the pseudoscalar decay constant fsub(F), or the wave function at origin of the s wave anti c s bound state in the potential picture, and help to clarify dynamical properties of heavy meson binding.

7653 **Multiple bremsstrahlung in gauge theories at high energies. Part 4. The process $e^+e^-\to\gamma\gamma\gamma\gamma$.** Berends, F.A.; Kleiss, R.; Wu, T.T.; Causmaecker, P. de; Gastmans, R.; Troost, W. (Rijksuniversiteit Leiden, Netherlands). *Nuclear Physics [Section] B;* **239**: No. 2, 395-409(9 Jul 1984). Contract AC02-76ER03227.

Also published as report DESY--83-126.

We calculate the helicity amplitudes and the cross section for the process $e^+e^-\to4\gamma$ in the high-energy limit. The resulting expressions are presented in a form which allows an easy numerical evaluation. They are valid for the kinematical configurations where at most two photons are emitted in directions nearly parallel to the lepton directions.

7654 **Relation of the cosmological constraints on neutrino flavors to the width of the $Z^0$.** Schramm, D.N.; Steigman, G. (Chicago Univ., IL). *Physics Letters, [Section] B;* **141**: No. 5/6, 337-341(5 Jul 1984).

The relationship between big band nucleosynthesis constraints on the number of types of neutrinos and the width of the $Z^0$ is discussed. The standard model with msub($\nu$)<msub(Z) has a well known relationship between the width of the $Z^0$, GAMMAsub(Z), and the number of neutrinos, Nsub($\nu$). However, for a heavy neutrino, with 1 MeV < or approx. msub($\nu$) < msub(Z)/2 there will be a contribution to the width of the $Z^0$, which will not be counted by primordial nucleosynthesis. On the other hand, right-handed neutrinos or light supersymmetric inos may not couple directly to the $Z^0$ and thus not contribute to GAMMAsub(Z) but could make a contribution to Nsub($\nu$). No model is cosmologically acceptable with more than 4 effective neutrinos (or 1 more than $\nu$sub(e), $\nu$sub($\mu$) and $\nu$sub(tau)). If GAMMAsub(Z)> or approx.3.4 GeV then other new massive particles must exist.

7655 **Parametrization of the elastic sector of the nucleon-nucleon scattering matrix. II.** Bryan, R. (Department of Physics, Texas A&M University, College Station, Texas 77843). *Physical Review [Section] C: Nuclear Physics;* **30**: No. 1, 305-313(Jul 1984). Contract AS05-76ER05223.

We present a method for parametrizing the 2 x 2 S matrix for coupled-partial-wave nucleon-nucleon elastic scattering above the pion-production threshold; the prescription is to introduce two dummy absorptive channels and then to parametrize the consequent 4 x 4 S matrix so that it is unitary and symmetric. The elastic but nonunitary 2 x 2 NN S matrix is then recovered as a submatrix of the 4 x 4 matrix. We parametrize the 4 x 4 S matrix by generalizing the prescription of Stapp, Ypsilantis, and Metropolis. The six real parameters that appear in the nonunitary NN sub S matrix are well behaved as the interaction vanishes. Three of them parametrize absorption and appear in a real, symmetric 2 x 2 matrix N which plays a role analogous to the absorption parameter eta for uncoupled waves. When there is no absorption, N = 1 /sub 2times2/ and the 2 x 2 NN S matrix reverts to the standard Stapp-Ypsilantis-Metropolis form. We use a different set of 4 x 4 matrices to parametrize absorption than was used in the first paper in this series, with the result that the four sets of parameters that reproduce a given S matrix are related by simple sign changes. The problem of the nontrivially related double solutions of the first paper is thus avoided.

7656 **Monoponucleosis--The wonderful things that monopoles can do to nuclei if they are there.** Lipkin, H.J. (Weizmann Inst. of Science, Rehovot). pp 347-358 of Monopole '83. Stone, J.L. New York, NY, USA; Plenum Press (1984). (CONF-8310227—).

From Monopole '83 conference; Ann Arbor, MI, USA (6 Oct 1983).

This chapter examines nuclear physics in strong magnetic fields. Topics considered include the mixing of singlet and triplet states of deuteron-like positronium, the production of a new kind of nuclear matter with nucleon moments oriented in the field, the catalysis of nuclear fission, the catalysis of nuclear fusion (with implications for solar neutrinos), and the enhancement of forbidden decays like triplet positronium (e.g., fission products).

7657 **Monopole catalysis: An overview.** Dawson, S. (Lawrence Berkeley Lab., Univ. of California, Berkeley, CA). pp 229-237 of Monopole '83. Stone, J.L. New York, NY, USA; Plenum Press (1984). (CONF-8310227—).

From Monopole '83 conference; Ann Arbor, MI, USA (6 Oct 1983).

This chapter reviews lectures given on the topic of monopole catalysis of baryon number violating processes. Subjects considered include the fermion-monopole scattering processes, charge conservation in the fermion-monopole system and its relationship to gauge invariance, and monopole catalysis resulting from monopoles with charges larger than a Dirac charge and from monopoles with a different topology than those of the SU(5) grand unified theory. Special emphasis is placed on the conservation laws which determine the allowed monopole-fermion interactions and on catalysis as a probe of the structure of a grand unified theory.

7658 **Conservation laws in the monopole-fermion system.** Sen, A. (Fermi National Accelerator Lab., Batavia, IL). pp 185-193 of Monopole '83. Stone, J.L. New York, NY, USA; Plenum Press (1984). (CONF-8310227—).

From Monopole '83 conference; Ann Arbor, MI, USA (6 Oct 1983).

This chapter examines monopole induced baryon number violation in terms of the conservation laws in the monopole fermion system. It is shown that the conservation laws of the full four dimensional gauge theory indicate baryon number violating processes in the monopole fermion system. The conservation of electric charge in such systems is discussed. It is concluded that conservation laws derived from the full four dimensional Lagrangian of the fermion-gauge field-Higgs system, together with the restriction on the fermions to be in the J=O partial wave, uniquely lead to baryon number violating processes. Total charge of the fermion-monopole system is exactly conserved, although the monopole ground state may make virtual transition to states containing fermion field carrying a net charge, and an equal and opposite charge at the core.

## 6453 Particle Invariance Principles And Symmetries

*REFER ALSO TO CITATION(S) 6453007623, 7631, 7644, 7675, 7676, 7679, 7688*

7659 **(BNL—35177) Chiral soliton model of hadron structure.** Kahana, S.H. (Brookhaven National Lab., Upton, NY (USA)). 1984. Contract AC02-76CH00016. 27p. (CONF-8407104—1). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85001928.

From Gordon conference; Tilton, NH, USA (9 Jul 1984).

The notes cover the chiral soliton model of hadron structure, its relevance to hadron substructure and strong interactions at low energy, the quantum chromodynamic underlying theory, and some new features, such as the Dirac sea of partons and the nature of the pion. Explicit chiral invariance and conserved chiral currents are discussed, as well as skyrmions. (LEW)

7660 **(IC—83/191) Higher order Lie-Baecklund symmetries of evolution equations.** Roy Chowdhury, A.; Roy Chowdhury, K.; Paul, S. (International Centre for Theoretical Physics, Trieste (Italy)). Oct 1983. 7p. NTIS (US Sales Only), PC A02/MF A01. File Number DE84703193.

We have considered in detail the analysis of higher order Lie-Baecklund symmetries for some representative nonlinear evolution equations. Until now all such symmetry analyses have been restricted only to the first order of the infinitesimal parameter. But the existence of Baecklund transformation (which can be shown to be an overall sum of higher order Lie-Baecklund symmetries) makes it necessary to search for such higher order Lie-Baecklund symmetries directly without taking recourse to the Baecklund transformation or inverse scattering technique.

7661 (KEK—82-1, pp 612-620) **Flavor asymmetry.** Watanabe, Y. (Tokyo Univ. (Japan). Dept. of Physics). May 1982. NTIS (US Sales Only), PC A16/MF A01. File Number TI85780079. (CONF-8111151—).

From 2. workshop on detectors for TRISTAN; Tsukuba, Japan (6 Nov 1981).

Although the $Z^0$ is not produced directly at TRISTAN, its presence produces large effect on the $e^+e^-$ annihilation into leptons and hadrons. The total cross sections relative to the QED $\mu$-pair production are shown, and clearly, hadron production is very sensitive. The effect of the $Z^0$ is also very noticeable in the angular distribution of $e^-e^+ \rightarrow$ f anti-f, where f is $\mu^-$, $(tau)^-$, u, d, s, c, b or t. The measurement of the distorted angular distribution of lepton pair production is straight forward, however, that of hadron production requires the identification of quark flavor. One well known way to distinguish quark flavor is the weighted charge method. A little more effective way is to use $K^{+-}$ as a flavor identifier. Leading $K^- = s$ anti-u ($K^+$ = anti-su) signifies parent (anti-) quark flavor. The momentum spectra of the leading $K^-$ from hadron jets originating from different quark flavors at $\sqrt{s} = 60$ GeV as predicted by the Lund Monte Carlo are shown. A hard $K^-$ spectrum from squarks is seen, but the cross section is still suppressed. Now, a simple method to tell forward from backward direction by finding leading $K^{+-}$ in each jet is obtained. The result of a Monte Carlo simulation at $\sqrt{s} = 60$ GeV is summarized. One powerful way is to add dE/dx capability to the track chamber.

7662 **(LBL—18402) Report of the working group on CP violation and rare decays.** Cronin, J.W.; Deshpande, N.G.; Kane, G.L.; Luth, V.C.; Odian, A.C.; Machacek, M.E.; Paige, F.; Schmidt, M.P.; Slaughter, J.; Triling, G.H. (Chicago Univ., IL (USA). Dept. of Physics; Oregon Univ., Eugene (USA). Dept. of Physics; Michigan Univ., Ann Arbor (USA). Dept. of Physics; Stanford Linear Accelerator Center, CA (USA); Northeastern Univ., Boston, MA (USA). Dept. of Physics; Brookhaven National Lab., Upton, NY (USA)). Oct 1984. Contract AC03-76SF00098. 12p. (CONF-8406198—23). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003470.

From Design and utilization of the superconducting super collider summer study; Snowmass, CO, USA (23 Jun 1984).

It has been pointed out that, with its high energy and luminosity, the SSC may provide the best or only way in which CP violation in heavy meson decays or the rare decay modes of such mesons can be observed. The major problem in the exploitation of the high rates of heavy quark production is the identification of interesting decays in the midst of a large background of more conventional processes. There have been some optimistic reports on the feasibility of such experiments, but relatively little quantitative backup has been provided. In the present report, we concentrate exclusively on B-meson decays. As is the case for K mesons, but not for charm or top decays, the favored modes are suppressed by the smallness of Cabibbo-Kobayashi-Maskawa angles, and therefore rare modes are relatively more frequent and potentially easier to observe.

7663 **(SLAC-PUB—3373) Axions in astrophysics and cosmology.** Sikivie, P. (Stanford Linear Accelerator Center, CA (USA); Florida Univ., Gainesville (USA). Dept. of Physics). Jul 1984. Contract AC03-76SF00515. 13p. (CONF-8405155—5). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85002720.

From Inner space/outer space conference; Batavia, IL, USA (2 May 1984).

Axion models often have a spontaneously broken exact discrete symmetry. In that case, they have discretely degenerate vacua and hence domain walls. The properties of the domain walls, the cosmological catastrophe they produce and the ways in which this catastrophe may be avoided are explained. Cosmology and astrophysics provide arguments that imply the axion decay constant should lie in the range $10^8$ GeV $\leqq$ f/sub a/ $\leqq 10^{12}$ GeV. Reasons are given why axions are an excellent candidate to constitute the dark matter of galactic halos. Using the coupling of the axions to the electromagnetic field, detectors are described to look for axions floating about in the halo of our galaxy and for axions emitted by the sun. (LEW)

7664 **(SLAC-PUB—3461) Supersymmetric sigma models.** Bagger, J.A. (Stanford Linear Accelerator Center, CA (USA)). Sep 1984. Contract AC03-76SF00515. 22p. (CONF-8408127—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85002607.

From NATO advanced study institute on supersymmetry; Bonn, F.R. Germany (20 Aug 1984).

We begin to construct the most general supersymmetric Lagrangians in one, two and four dimensions. We find that the matter couplings have a natural interpretation in the language of the nonlinear sigma model.

7665 **Fractional indices in supersymmetric theories.** Boyanovsky, D.; Blankenbecler, R. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). *Physical Review [Section] D: Particles and Fields;* **30**: No. 8, 1821-1824(15 Oct 1984).

The regularized index introduced by Witten for supersymmetric theories and discussed by Callias for elliptic operators is studied. We relate this index to Levinson's theorem for potential scattering and clarify its meaning even when it takes on fractional values. The index can be (and usually is) half-integer whenever the continuum in the spectrum extends down to zero energy.

## 6454 Field Theory

*REFER ALSO TO CITATION(S) 6454007565, 7568, 7569, 7607, 7622, 7657, 7659, 7903, 7904, 7912*

7666 **(BNL—35379) Some remarkable spin physics with monopoles and fermions.** Craigie, N.S. (Brookhaven National Lab., Upton, NY (USA)). 1984. Contract AC02-76CH00016. 13p. (CONF-8409162—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003207.

From 6. international symposium on high energy spin physics; Marseille, France (12 Sep 1984).

This review will cover the following topics, which follow the historical evolution of the subject: the Dirac monopole; the Kazama-Yang Goldhaber problem in electron-monopole scattering; the 't Hooft-Polyakov monopole and spin from isospin; the Rubakov analysis; monopole catalysis of proton decay the Rubakov-Callan effect; the role of exactly solvable 2-dimensional QFT's and finally observable consequences. 15 references.

7667 **(CONF-8408129—1) Soap opera: the sad tale of the quark.** Lipkin, H. (Argonne National Lab., IL (USA)). 1984. Contract W-31-109-ENG-38. 38p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85002724.

From Conference on the quark structure of matter; Scarborough, Ontario, Canada (11 Aug 1984).

The history of quark physics is briefly reviewed, followed by an introduction to quantum chromodynamics, leading terms, and the OZI rule. The basic physics of hadron structure as revealed by experiment is then discussed, followed by the models used to treat it. The two complementary models are the quasinuclear colored quark model and the quark-parton model. Another model for orthogonal physical properties is the bag model. Several applications of the constituent quark model are considered, including hadron masses, spin physics, and multiquark physics. The theoretical basis

and phenomenology of the OZI rule forbids processes described by disconnected quark line diagrams. (LEW)

7668 **(CONF-8410144—2) Accidental degeneracies, hidden supersymmetries, and spectrum-generating superalgebras.** Balantekin, A.B. (Oak Ridge National Lab., TN (USA)). 1984. Contract AC05-84OR21400. 6p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85003547.

From International symposium on nuclear shell model; Philadelphia, PA, USA (31 Oct 1984).

Recently, several Hamiltonians appeared in the literature which exhibit degeneracies that do not seem to be explainable in terms of hidden symmetry groups. Such Hamiltonians are shown to constitute supersymmetric quantum-mechanical systems. The concept of spectrum-generating superalgebras is introduced and coordinate space representations of the relevant non-compact superalgebras Osp(1/2) and SU(1,1/1) are exhibited.

7669 **(DESY—84-034) Monte Carlo study of glueball masses in SU(2).** Meyer-Ortmanns, H.; Montvay, I. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Apr 1984. 14p. NTIS (US Sales Only), PC A02/MF A01. File Number DE84752297.

The multi-hit technique proposed by Parisi, Petronzio and Rapuano for the measurement of correlations is applied to the calculation of glueball masses in SU(2) lattice gauge theory. The value of the mass gap ($0^+$ glueball mass) turns out to be msub(0+) = (166 +- 15) Asub(latt) or (1090 +- 170) MeV, if recent string tension determinations are taken for the scale.

7670 **(IC—83/32) Kaluza-Klein idea: Status and prospects.** Mecklenburg, W. (International Centre for Theoretical Physics, Trieste (Italy)). Jan 1983. 98p. NTIS (US Sales Only), PC A05/MF A01. File Number DE84703184.

The present status of the Kaluza-Klein idea is reviewed, including a discussion of the fermionic sector. Formalism and geometrical methods necessary for the formulation of high-dimensional field theories are described in some detail. The mechanism of spontaneous compactification is explained and a description of presently available models is given. A chapter on coset space reduction of high dimensional Yang-Mills theories is included. The review concludes with an outlook on supersymmetric models.

7671 **(IC—83/44) Infinite sets of conservation laws for linear and non-linear field equations.** Mickelsson, J.; Niederle, J. (International Centre for Theoretical Physics, Trieste (Italy)). May 1983. 13p. NTIS (US Sales Only), PC A02/MF A01. File Number DE84703192.

The relation between an infinite set of conservation laws of a linear field equation and the enveloping algebra of the space-time symmetry group is established. It is shown that each symmetric element of the enveloping algebra of the space-time symmetry group of a linear field equation generates a one-parameter group of symmetries of the field equation. The cases of the Maxwell and Dirac equations are studied in detail. Then it is shown that (at least in the sense of a power series in the "coupling constant") the conservation laws of the linear case can be deformed to conservation laws of a non-linear field equation which is obtained from the linear one by adding a non-linear term invariant under the group of space-time symmetries. As an example, our method is applied to the Korteweg-de Vries equation and to the massless Thirring model.

7672 **(IC—83/155) Quantization of O(N) non-linear sigma models as the stochastic motion on Ssup(N-1).** Aldazabal, G.; Parga, N. (International Centre for Theoretical Physics, Trieste (Italy)). Sep 1983. 16p. NTIS (US Sales Only), PC A02/MF A01. File Number DE84703185.

We obtain the Langevin equations for the stochastic quantization of the O(N) non-linear sigma model by studying the random (Gaussian) motion on the sphere Ssup(N-1). We prove the equivalence of this procedure with a different one where the random forces are elements of the O(N) algebra. A proof that our approach yields in the equilibrium regime the quantum field theory is also given.

7673 **(IC—83/185) Inverse scattering approach to the soliton solutions of SO(2,1) nonlinear sigma model.** Roy Chowdhury, A.; Mukherjee, J. (International Centre for Theoretical Physics, Trieste (Italy)). Oct 1983. 18p. NTIS (US Sales Only), PC A02/MF A01. File Number DE84703186.

We have considered in detail the analysis of the IST equations for nonlinear $\sigma$-model with SO(2,1) invariance. The required Gel'fand-Levitan equation is set up by taking care of the proper analyticity in the eigenvalue plane. It is interesting to note that in the particular asymptotic limit of the field variable under consideration the Gel'fand-Levitan equation is of integro-differential type, but can be solved in an algebraic way. We have obtained explicit formulae for the one soliton solution which can be easily extended to the N soliton case.

7674 **(IC—83/190) Analysis of Green's functions and stability problem in models of quantum field theory with solitons.** Raczka, R.; Roszkowski, L. (International Centre for Theoretical Physics, Trieste (Italy)). Oct 1983. 32p. NTIS (US Sales Only), PC A03/MF A01. File Number DE84703187.

A class of models of quantum field theory for a multiplet phi-vector=(phi$_1$,...,phisub(N)) of real scalar fields, possessing a particle-like classical solution phi-vector$_0$, is considered. A new formula for generating functional for time-ordered Green's functions in terms of effective propagators is derived. The problem of classical and quantum stability is analyzed in detail. It is shown by partly non-perturbative analysis that in the considered models the excited states of mesons do exist and form the trajectories in the plane mass$^2$-spin. These trajectories are linear or approximately linear like experimental trajectories.

7675 **(IC—83/201) New approach to supersolitons of supersymmetric non-linear equations.** Roy Chowdhury, A. (International Centre for Theoretical Physics, Trieste (Italy)). Oct 1983. 12p. NTIS (US Sales Only), PC A02/MF A01. File Number DE84703188.

The method of Zakharov and Mikhailov has been extended to obtain super-soliton solutions of nonlinear supersymmetric equations. The super Lax equations have been shown to be gauge invariant which is the key point in the construction of the solution. Our approach avoids the difficulties associated with the definition of the Jost function in the super-space and the subsequent implementation of the inverse scattering technique to supersymmetric Lax pairs.

7676 **(IC—83/204) Instantons and condensates in supersymmetric CPsup(N-1) models.** Narain, K.S. (International Centre for Theoretical Physics, Trieste (Italy)). Nov 1983. 31p. NTIS (US Sales Only), PC A03/MF A01. File Number DE84703189.

Partition function in the multi-instanton background for supersymmetric CPsup(N-1) model is calculated, which is shown to be supersymmetry invariant. This is used to calculate Green's function involving N pairs of psi-barpsi(xsub(i)), which turns out to be independent of the positions. A possible interpretation is that the composite field psi-barpsi acquires vacuum expectation value. The results are in agreement with those obtained in 1/N expansion.

7677 **(IC—83/207) Thermo field theory versus imaginary time formalism.** Fujimoto, Y.; Nishino, H.; Grigjanis, R. (International Centre for Theoretical Physics, Trieste (Italy)). Nov 1983. 10p. NTIS (US Sales Only), PC A02/MF A01. File Number DE84703190.

We calculate a two-loop diagram at finite temperature to compare Thermo Field Theory (=Th.F.Th.) with the conventional imaginary time formalism (=Im.T.F.). The summation over the Matsubara frequency in Im.T.F. is carried out at two-loop level, and the result is shown to coincide with that of Th.F.Th. We confirm that in Im.T.F. the temperature dependent divergences cancel out at least in the calculation of effective potential of phi$^4$ theory, as in Th.F.Th.

7678 **(IC—83/209) Free massless fields with low spin values on the Einstein static universe.** Tarski, J. (International Centre for Theoretical Physics, Trieste (Italy)). Nov 1983. 11p. NTIS (US Sales Only), PC A02/MF A01. File Number DE84703191.

Quantized fields on the Einstein static universe, which are induced from tangent spaces, are considered. A global embedding of the different representation spaces is suggested. Fields with spin 1/2 and 1 as well as scalar fields are discussed.

7679 **(IC—83/230) Super-symmetrical preon model with SU(2)sub(L)xSU(2)sub(R)xU(1)sub(B-L) symmetry broken by coupling to supergravity.** Dai Yuan-ben. (International Centre for Theoretical Physics, Trieste (Italy)). Dec 1983. 7p. NTIS (US Sales Only), PC A02/MF A01. File Number DE84703228.

A supersymmetrical preon model is proposed. In this model there are Higgs particles which are massless at the scale of confinement of hypercolor due to the supersymmetry and a discrete R symmetry. We show that in this model the low energy gauge symmetry SU(2)sub(L)xSU(2)sub(R)xU(1)sub(B-L) can be broken to U(1)sub(Q) at the scale of supersymmetry breaking by coupling to supergravity.

7680 **(IC—84/1) QCD sum rules, the spontaneous breakdown of chiral symmetry and short distance behaviour in lattice gauge theories.** Craigie, N.S.; Katznelson, E.; Rebbi, C. (International Centre for Theoretical Physics, Trieste (Italy)). Jan 1984. 16p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700099.

We analyze the behaviour that correlation functions ought to have on the lattice in order to reproduce QCD sum rules in the continuum limit. We formulate a set of relations between lattice correlation functions of meson operators at small time separation and the quark condensates responsible for spontaneous breakdown of chiral symmetry. We suggest that the degree to which such relations are satisfied will provide a set of consistency checks on the ability of lattice Monte Carlo simulations to reproduce the correct spontaneous chiral symmetry breaking of the continuum limit.

7681 **(IC—84/4) Coleman Weinberg model in Einstein spacetime.** Denardo, G.; Spallucci, E. (International Centre for Theoretical Physics, Trieste (Italy)). Feb 1984. 20p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700102.

We study radiative symmetry breaking, a la Coleman-Weinberg, in the geometry of a static Einstein Universe. We prove that the symmetric ground state $<0'phi'0>=0$, in a non-minimally coupled massless lambda $phi^4$ theory, can become unstable at high curvature only if $0<=xi$ approx.= $lambda<<1$. As far as massless scalar QED is concerned, we find that phase transitions can already occur at low curvature. These conclusions are improved by means of Renormalization Group techniques.

7682 **(IC—84/11) Non-linear sigma model and zero mass bound states of $QCD_2$.** Craigie, N.S.; Nahm, W. (International Centre for Theoretical Physics, Trieste (Italy)). Feb 1984. 10p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700100.

We analyze massless two-dimensional gauge theories and discuss under what circumstances they lead to non-linear sigma models. In particular we show how one is led to conclude that the zero mass bound state sector of $QCD_2$ with Nsub(c)=2 and a single flavour may be described by a unique non-linear sigma model with an SU(2) global symmetry.

7683 **(IC—84/12) Neutral current interactions beyond the standard SU(2)sub(L)xU(1) model.** Rajpoot, S. (International Centre for Theoretical Physics, Trieste (Italy)). Mar 1984. 33p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85700132.

Unification of the conventional quarks and lepton families through gauge interactions requires mirror fermions in order to avoid vector-like weak interactions. Such a family gauge symmetry F can contribute additionally to the neutral current of the standard SU(2)sub(L)xU(1) model of electroweak interactions. This motivates the extension of the standard model by an additional U(1)sub(F) neutral current. Depending on the assignment of the fermion families, the U(1)sub(F) neutral current contribution of the conventional fermions is (+-)-vectorial or (+-)-axial vectorial. In all these four cases, the effective SU(2)sub(L)xU(1)xU(1)sub(F) model has one neutral boson almost equal to the neutral boson of the standard SU(2)sub(L)xU(1) model and the second neutral boson can be (a) lighter than, (b) almost degenerate with, (c) heavier than the neutral boson mass of the standard SU(2)sub(L)xU(1) model. This mass spectrum of the neutral boson occurs for values of the U(1)sub(F) gauge coupling less than one-half of the SU(2)sub(L) gauge coupling.

7684 **(IC—84/26) Gauge theories in external electromagnetic fields: The standard SU(2)xU(1) model.** Mukku, C. (International Centre for Theoretical Physics, Trieste (Italy)). Feb 1984. 44p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85700101.

Spontaneously broken SU(2)xU(1) electroweak theory in a constant background electromagnetic field is shown to admit a phase transition to a restored symmetry phase for large values of the external field. Allowing for two arbitrary parameters, the Higgs mass and the expectation value of the Higgs field, we derive a lower bound on the critical magnetic field required for restoration. The configuration space heat kernel method adapted to dimensional regularization techniques is used allowing calculations to be performed in arbitrary renormalizable gauges.

7685 **(IC—84/29) Classification of finite groups with four generators, three of which having orders p,p,q (p<q). I.** Yacoub, K.R. (International Centre for Theoretical Physics, Trieste (Italy)). Mar 1984. 15p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700092.

Finite groups with two independent generators attracted the attention of authors for several years. The author, having started on such groups in his PhD Thesis in 1953, discussed later on the existence and the structure of finite groups with three generators, one being of arbitrary order and the other two having given orders [Pub. Math. Debrecen, 11, 32-38(1964), 13, 9-16(1966)] and others. Recently, the author started the problem of finite groups with four generators a,b,c and d when b,c and d have the same odd prime order p. It is the object of the present paper to deal with a similar problem when the given orders are p, p and q with p<q. Throughout this paper, the order m of a is arbitrary but m is not an element of set containing p,q. The case p>q together with the particular case when m is an element of set containing p,q will be kept to a further discussion. The present paper consists actually of two main parts, the first deals with the case p does not divide q-1 while the second deals with the case p divides q-1.

7686 **(IC—84/30) Classification of finite groups with four generators, three of which having prime orders p,q,q (p<q). II.** Yacoub, K.R. (International Centre for Theoretical Physics, Trieste (Italy)). Mar 1984. 15p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700093.

In a previous paper, the author discussed the existence and the structure of finite groups with four generators a,b,c and d when the orders of b,c,d are respectively p,p,q with p<q. The case p<q, or equivalently the case when the orders of b,c,d are respectively p,q,q with p<q is discussed in the present paper. As in the previous paper, the order m of a is arbitrary but m is not an element of the set containing p,q.

7687 **(INS—469) Weak-symmetry breaking and top-quark mass in softly broken supersymmetric models.** Komatsu, H. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). May 1983. 15p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700133.

The general formula of the softly breaking mass parameters are presented as the solutions for the renormalization group equations in the supersymmetric standard model. The weak gauge symmetry breaking is derived from the effects of the Yukawa coupling. The top quark mass is bounded in various different boundary conditions.

**7688 Constraints on soft parameters in finite N = 2 supersymmetry for arbitrary gauge groups.** Frere, J.; Mezincescu, L.; Yao, Y. (Randall Laboratory of Physics, University of Michigan, Ann Arbor, Michigan 48109). *Physical Review [Section] D: Particles and Fields;* **30**: No. 10, 2238-2241(15 Nov 1984).

We consider any finite N = 2 supersymmetry with an arbitrary internal-symmetry group and solve the constraints on the soft-breaking parameters.

**7689 Time dependence of the Skyrme soliton.** Liu, K.F.; Zhang, J.S. (Department of Physics and Astronomy, University of Kentucky, Lexington, Kentucky 40506). *Physical Review [Section] D: Particles and Fields;* **30**: No. 9, 2015-2018(1 Nov 1984).

Small oscillations of the static Skyrme soliton are considered. It is found that the Skyrme soliton is stable against small oscillations and there is no bound state. The meson—soliton scattering phase shifts are calculated. A resonance is found at ~250—300 MeV above the nucleon, which is only halfway from the Roper resonance N((1440). Small oscillations are also considered for spinning Skyrme solitons. The results are similar. Some implications and difficulties associated with spinning solitons are discussed.

**7690 Gravitational contribution to the Casimir energy in Kaluza-Klein theories.** Chodos, A.; Myers, E. (Department of Physics, Yale University, New Haven, Connecticut 06511). *Annals of Physics (New York);* **156**: No. 2, 412-443(Sep 1984). Contract AC02-76ER03075.

The Casimir energy of the gravitational field in Kaluza-Klein theories is investigated. The mathematical techniques needed to compute the contribution of a single graviton loop to the quantum effective potential on a background manifold of (Minkowski space)x(N-sphere) are developed. In these computations the cosmological constant plays a dynamical role, acting like a mass for the graviton. The numerical work for the case N = 1 is done explicitly, and a solution to the one-loop corrected equations of motion is found, although it is not stable. The possibility of an imaginery part of the effective potential for N>1 is noted, and its existence is attributed to tachyonic terms in the mode sum.

**7691 Effective spin model for the finite temperature twisted Eguchi-Kawai model.** Gocksch, A.; Neri, F.; Rossi, P. (Brookhaven National Lab., Upton, NY). *Physics Letters, [Section] B;* **143**: No. 1-3, 207-209(9 Aug 1984).

Following recent work by Ogilvie we derive an effective spin model for the finite temperature Eguchi-Kawai model and compare its predictions to Monte Carlo data previously obtained by the authors.

**7692 Linearization of the Baker-Ball-Zachariasen gluon propagator equation.** Atkinson, D.; Johnson, P.W. (Argonne National Lab., IL). *Nuclear Physics [Section] B;* **241**: No. 1, 189-203(16 Jul 1984).

The linearized version of the axial-gauge gluon Dyson-Schwinger equation is shown to have a solution with the infrared behavior $Ap^{-4} + B(p^2)^{sup(-0.8263)}$, where p is the gluon momentum. This result supports the calculation by Baker, Ball and Zachariasen of the QCD dielectric constant in the IR limit.

**7693 Meson field quenching of proton decay.** Goldhaber, A.S.; Goldman, T.; Nussinov, S. (State Univ. of New York, Stony Brook). *Physics Letters, [Section] B;* **142**: No. 1/2, 47-51(12 Jul 1984).

The baryon-to-lepton transition operators of grand unified theories could act as strong sources of meson fields, with the resulting field configurations, as computed classically, being kinematically forbidden. The consequent barrier penetration factors may suppress the proton decay rate by an order of magnitude below bounds obtained in previous calculations. This means that SU(5) remains barely compatible with limits on the decay $p \rightarrow e^+ \pi^0$. We obtain tau/Bsub(eπ) < or approx. $10^{32}$ yr.

**7694 Multiple bremsstrahlung in gauge theories at high energies. Part 3. Finite mass effects in colinear photon bremsstrahlung.** Berends, F.A.; Kleiss, R.; Causmaecker, P. de; Gastmans, R.; Troost, W.; Wu, T.T. (Rijksuniversiteit Leiden, Netherlands). *Nuclear Physics [Section] B;* **239**: No. 2, 382-394(9 Jul 1984). Contract AC02-76ER03227.

Also published as report DESY--83-125.

We present a method for calculating the various spin amplitudes for QED processes in which an arbitrary number of photons is radiated in directions nearly parallel to the fermion directions. This is accomplished by introducing explicit polarization vectors for the photons and by working in the high energy limit, where finite mass effects are treated in leading order.

**7695 Effective strong coupling lattice model for finite temperature QCD.** Gocksch, A.; Ogilvie, M. (Brookhaven National Lab., Upton, NY). *Physics Letters, [Section] B;* **141**: No. 5/6, 407-410(5 Jul 1984).

We present a strong coupling lattice model for finite temperature QCD. It is shown to contain what are though to be the essential features of the underlying theory: At a finite physical temperature Tsub(D) we observe the remnants of the deconfining phase transition. At low temperatures chiral symmetry is broken but is restored at a temperature Tsub(ch)>Tsub(D). The zero temperature spectrum is computed and estimates for Tsub(ch), Tsub(D) are given.

**7696 Implications of quantum chromodynamic sum rules for sizes of nucleon and Δ baryon.** Pasupathy, J.; Marshak, R.E. (Physics Department, Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061). *Physical Review [Section] C: Nuclear Physics;* **30**: No. 1, 265-269(Jul 1984). Contract AS05-80ER10713.

The residues of the nucleon and Δ baryon poles in the baryonic current propagator are evaluated for the MIT and chiral bag models. It is found that the values obtained with a bag radius of 0.8 to 1 fm match those predicted by the quantum chromodynamic sum rules which take into account the chiral structure of the physical vacuum state. Smaller bag radii give increasingly poorer agreement.

**7697 Magnetic monopoles in grand unified and Kaluza-Klein theories.** Shafi, Q. (Univ. of Delaware, Newark, DE). pp 47-49 of Monopole '83. Stone, J.L. New York, NY, USA; Plenum Press (1984). (CONF-8310227—).

From Monopole '83 conference; Ann Arbor, MI, USA (6 Oct 1983).

This chapter demonstrates that grand unified theories based on gauge groups larger than SU(5) present novel possibilities for magnetic monopole charges and their masses. Magnetic monopoles in Kaluza-Klein theories are characterized as non-trivial $S^1$ bundles over $S^3$, where the latter forms the boundary of 3-space. There are an infinite number of such bundles and each is labelled by an integer. The existence of topologically stable magnetic monopoles is indicated.

**7698 Vacuum anti-shielding of monopoles.** Goebel, D.J. (Univ. of Wisconsin--Madison, WI). pp 339-346 of Monopole '83. Stone, J.L. New York, NY, USA; Plenum Press (1984). (CONF-8310227—).

From Monopole '83 conference; Ann Arbor, MI, USA (6 Oct 1983).

This chapter examines the difficulties in calculating the vacuum polarization, or magnetization, induced in the vacuum by a monopole. The usual Lagrangian formalism and consequent Feynman rules do not apply. Another problem is that the interaction strength between the monopole and a charge is not small (unless it vanishes exactly) because it is quantized to half integer values. Perturbation theory is therefore not applicable. The discussed problems are solved by using the old fashioned method of calculating a vacuum expectation value as a sum over single particle modes.

**7699 Status of the Texas A & M GUT monopole search.** Webb, R.C. (Texas A & M Univ., College Station, TX). pp 581-588 of Monopole '83. Stone, J.L. New York, NY, USA; Plenum Press (1984). (CONF-8310227—).

From Monopole '83 conference; Ann Arbor, MI, USA (6 Oct 1983).

This chapter describes the use of a large area (approx. 53 $m^2$) scintillation counter telescope to detect the passage of a slow moving, superheavy, magnetic monopole. The detector is described and the expected signature for a passing magnetic monopole is presented. The detector utilizes acrylic based scintillation material as the detector medium. The electronics for the monopole search were selected and designed to be sensitive to the properties of the Grand Unified Theory (GUT) monopoles. The described experiment is located underground at a depth of 1500' in a nearby salt mine.

# 65 PHYSICS. II.

## 6510 Nuclear Physics

*REFER ALSO TO CITATION(S) 6510008083*

7700 **(INIS-mf—9083) NIKHEF-K Annual Report July 1982 - June 1983.** (Nationaal Inst. voor Kernfysica en Hoge-Energiefysica (NIKHEF), Amsterdam (Netherlands). Sectie K). Jul 1982. 93p. NTIS (US Sales Only), PC A05/MF A01. File Number DE85780131.

In this semi-annual report of NIKHEF-K, the current research on electron scattering and physics with pions, muons and baryons is described. The report is focussed on experiments and their (preliminary) results.

7701 **(INIS-mf—9084) NIKHEF Annual Report 1982.** (Nationaal Inst. voor Kernfysica en Hoge-Energiefysica (NIKHEF), Amsterdam (Netherlands)). Sum 1983. 120p. (In Dutch). NTIS (US Sales Only), PC A06/MF A01. File Number DE85780125.

In this annual report 1982, the NIKHEF research programs of high-energy physics, nuclear physics and radiochemistry is described in a wide context. Next, the reports of the individual projects of section-H and section-K are described in detail. Finally, the report gives some statistical information of publications, colloquia and co-workers.

7702 (INIS-SU—228, pp 237-254) **Electro- and photonuclear physics at intermediate energies; Saclay activities sipce 1970 and future prospects.** Schuhl, Cl. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Nucleaire a Haute Energie). 1982. NTIS (US Sales Only), PC A13/MF A01. File Number TI84780397. (CONF-8106173—).

From 5. seminar on electromagnetic interactions of nuclei at low and medium energies; Moscow, USSR (15 Jun 1981).

The report presents a review of experiments performed at the Saclay electron linear accelerator (SELA) with electron, photon, pion and muon beams, and shows the long range perspectives, of nuclear physics in that domain. The latter are those of a fully evolved science, where the dynamics of the nucleus are tackled not only in terms of nucleons, but also in terms of mesons and more recently, in terms of quarks and gluons. The limitations of the SELA for the type of experiments presently done and sketch the possibilities offered by a larger duty cycle and a higher energy is given. The interest of a 2 GeV accelerator with a large duty cycle seems evident in case one pursues a detailed study of mesonic degrees of freedom and to partly unveil the quark and gluon degrees of freedom. This machine would therefore permit nuclear physics to make an important advance towards the understanding of nuclear structure at very short distances and hadronic physics in general.

7703 **(INS-NUMA—36) Proceedings of the study meeting on nuclear physics of intermediate energy.** (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). May 1982. 96p. (In Japanese). (CONF-8112110—). NTIS (US Sales Only), PC A05/MF A01. File Number DE85780069.

From Meeting on nuclear physics of intermediate energy; Tanashi, Tokyo, Japan (14 Dec 1981).

Separate entries were made in the data base for the papers presented. (WHK)

7704 **(INS-NUMA—37) Reports of workshop on structure of hypernuclei.** (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Jun 1982. 154p. (In Japanese). (CONF-8201101—Exc.). NTIS (US Sales Only), PC A08/MF A01. File Number DE85780070.

From Workshop on structure of hypernuclei; Tanashi, Tokyo, Japan (18 Jan 1982).

Separate entries were made in the data base for the papers presented. (WHK)

7705 **(INS-PH—2) Proceedings of the study meeting on physics of two nucleon system.** (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). 20 Apr 1982. 127p. (In Japanese). (CONF-8201102—). NTIS (US Sales Only), PC A07/MF A01. File Number DE85780071.

From Meeting on physics of two nucleon systems; Tanashi, Tokyo, Japan (19 Jan 1982).

Separate entries were made in the data base for the papers presented. (WHK)

7706 (JAERI-M—83-041, pp 171-185) **Status of JENDL-3 compilation.** Asami, Tetsuo (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Mar 1983. (In Japanese). NTIS (US Sales Only), PC A11/MF A01. File Number TI83902446. (CONF-821193—; NEANDC(J)—90/AU; INDC(JAP)—77/G).

From JAERI seminar on nuclear data; Tokai, Japan (24 Nov 1982).

Japanese Nuclear Data Committee has already made a plan for JENDL (Japanese Evaluated Nuclear Data Library)-3, and has made plans to start work on the data evaluation for JENDL-3 since the current year. The status of the data evaluations and compilations as well as the outline of the plan for JENDL-3 are described. The variety of nuclides in JENDL-3 is compared with the ones of other large nuclear data libraries. Further problems on JENDL-3 compilations are also described.

7707 **(Juel-Spez—255) Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.** Baur, G.; Mayer-Boericke, C.; Schult, O.; Seyfarth, H.; Speth, J.; Turek, P. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Kernphysik). Apr 1984. 189p. NTIS (US Sales Only), PC A09/MF A01. File Number DE85750011.

This annual report contains extended abstracts of the work performed at the named institute together with a list of publications. The abstracts deal with nuclear reactions, nuclear spectroscopy, atomic collisions, solar energy, and technical developments. See hints under the relevant topics.

## 6511 Experimental Techniques

7708 **(INFN/BE—83-1) Scampi-a fortran program simulating charge and mass particle identification.** Guazzoni, P.; Michelato, P.; Sechi, G.; Zetta, L.; Binaghi, E.; Annunziata, M.; Fontaneto, M.G.; Mantica, P.; Pasquinucci, A.; Simonetto, A. (Istituto Nazionale di Fisica Nucleare, Milan (Italy)). 1983. 13p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700146.

This paper describes a fortran program simulating mass and charge ion discrimination using a SSD telescope, the time of flight technique and different algorithms for $MZ^2$ identification.

7709 (JAERI-M—83-041, pp 9-33) **Development of nuclear model codes for cross-section calculations in JNDC.** Igarasi, Sin-iti (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Mar 1983. (In Japanese). NTIS (US Sales Only), PC A11/MF A01. File Number TI83902446. (CONF-821193—; NEANDC(J)—90/AU; INDC(JAP)—77/G).

From JAERI seminar on nuclear data; Tokai, Japan (24 Nov 1982).

A review of JNDC activity on the development of nuclear model codes for cross-section calculations is presented. A rough

chronology of the JNDC activity is made, and activities of the nuclear data evaluation and other works in JNDC are briefly mentioned as background. Table of the codes available in JNDC is presented.

7710 (JAERI-M—83-041, pp 34-46) **Experimental work on the neutron cross-sections in Japan.** Sugiyama, Kazusuke (Tohoku Univ., Sendai (Japan)). Mar 1983. (In Japanese). NTIS (US Sales Only), PC A11/MF A01. File Number TI83902446. (CONF-821193—; NEANDC(J)—90/AU; INDC(JAP)—77/G).

From JAERI seminar on nuclear data; Tokai, Japan (24 Nov 1982).

The author presents a brief historical survey of developments in the last twenty years on experimental activities of the neutron cross-sections in Japan. A review is given on a figure and a table classified by neutron sources and the measurements which are refered to the Japanese progress reports to the EANDC and the NEANDC. The paper deals with distinctive features and problems for the experiments in Japan.

## 6512 Nuclear Properties And Reactions, A=1-5

*REFER ALSO TO CITATION(S) 6512107704, 7857*

7711 **(IC—84/16) Electron scattering from $^{6}$Li and $^{9}$Be.** Cheon, I.T. (International Centre for Theoretical Physics, Trieste (Italy)). Mar 1984. 16p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700137.

Transverse form factors for electron scattering from $^{6}$Li and $^{9}$Be have been calculated with the Cohen-Kurath wave functions, by using the phenomenological magnetic form factors of bound nucleons. The results show good agreement with the experimental data. The effects of meson exchange currents on the e.m. form factors appear in the region $q>=1.2fm^{-1}$ and improve the theoretical results.

7712 **(IC—84/17) Effect of the mass of odd-even nuclei on the quadrupole moments.** Hussein, H.M. (International Centre for Theoretical Physics, Trieste (Italy)). Mar 1984. 5p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700135.

Using shell model wave functions, the quadrupole moments for low-lying states in the case of even-odd nuclei as well as for the state $2^{+}$ for even-even nuclei have been studied. The calculated reduced quadrupole moments exhibit an attractive phenomena.

7713 (INIS-SU—228, pp 228-236) **Nuclear photodisintegration and dibaryon resonances.** Sorokin, P.V. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1982. (In Russian). NTIS (US Sales Only), PC A13/MF A01. File Number TI84780397. (CONF-8106173—).

From 5. seminar on electromagnetic interactions of nuclei at low and medium energies; Moscow, USSR (15 Jun 1981).

New investigations into deuterium photodisintegration for search of dibaryon resonances (DR) are discussed. Photonuclear reactions at 300-1000 MeV photon energies are convenient means of DR study with 2100-2400 MeV masses. All the conducted analyses of the present results are model-dependent because there is not enough experimental data on DR extraction in pp-, pn-, γd-processes. Two experiments conducted in Saklya are most informative. One of the experiments comprised study on dependence of $\gamma d \rightarrow p\pi^{-}p$ reaction cross section on photon energy. The authors note fast change of cross section at 400 MeV that may testify to DR appearance. The second experiment included study on $\gamma d \rightarrow pX$ proton yield at different focused values of outlet angle THETAp and pulse Pp of protons in respect to upper energy of photon bremsstrahlung spectrum. The analysis of proton yields at different THETAp and Pp values presupposes DR manifestation at Esub(γ)=390 MeV with 40 MeV width. Yields associated with DR formation in both experiments makes up approximately 5% of the experimentally determined one.

7714 (INS—476) **Strong coupled-reaction-channel scheme with the hybridization of the valence nucleon in the $^{13}$C+$^{13}$C system.** Imanishi, B.; Oertzen, W. von. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Jul 1983. 17p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700143.

It is confirmed that the strong coupled-reaction-channel effects observed in the system of $^{13}$C+$^{13}$C(gr.1/2$^{-}$;3.086MeV,1/2$^{+}$; 3.854MeV,5/2$^{+}$) are due to the hybridization between the 1p1/2 and the "reoriented" 1d5/2 orbitals of the valence neutron. The transfer processes play an essential role in the hybridization. This scheme is little influenced by the binding energies of the single particle states and is not affected by the absorption part of the optical potential between the two core nuclei.

7715 (Juel-Spez—255, pp 22-23) **Investigation of light nuclei at high excitation energies with three-body break-up reactions.** Franke, R.; Steinheuer, B.; Wingender, K.; Witsch, W. von; Machner, H. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

7716 **Fission of relativistic intermediate-mass nuclei.** Guo, S.; Tincknell, M.L.; Price, P.B. (Physics Department, University of California, Berkeley, California 94720). *Physical Review [Section] C: Nuclear Physics;* **30**: No. 5, 1737-1739(Nov 1984).

We have studied the fission of nuclei with 36< or =Z< or =79 produced in interactions of 1A GeV Au nuclei in CR-39 plastic track detectors. The energy released is typical of fission at lower energies, and the transverse momentum transferred to fissioning species is consistent with a peripheral interaction. The distributions of heavy-to-light fragment mass ratios are very broad, as in fission of nuclei with 28< or =Z< or =83 by 600 MeV and 1 GeV protons.

7717 **Configuration space Faddeev continuum calculations: N-d s-wave scattering lengths with tensor-force interactions.** Friar, J.L.; Gibson, B.F.; Payne, G.L.; Chen, C.R. (Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review [Section] C: Nuclear Physics;* **30**: No. 4, 1121-1129(Oct 1984).

Formulation of the s-wave, zero-energy Faddeev-type scattering equations for a model which includes a spin-triplet tensor-force nucleon-nucleon interaction and a Coulomb force between two protons is discussed. Numerical solution of the equations for the Reid-soft-core, Argonne $V_{14}$, and super-soft-core C potential models is obtained using spline techniques. Kohn variational estimates are also presented, and comparison is made with other previously published results. The inclusion of a tensor force does not alter our previous conclusions about the Coulomb force effects on the p-d scattering length, which were based upon s-wave nucleon-nucleon potential model studies.

7718 **Vector analyzing powers of $^{1}$H(d,γ) and $^{2}$H(p,γ) reactions at E/sub x/ = 6 MeV.** King, S.; Roberson, N.R.; Weller, H.R.; Tilley, D.R.; Engelbert, H.P.; Berg, H.; Huttel, E.; Clausnitzer, G. (Duke University and Triangle Universities Nuclear Laboratory, Duke Station, Durham, North Carolina 27706). *Physical Review [Section] C: Nuclear Physics;* **30**: No. 4, 1335-1338(Oct 1984). Contract AC05-76ER01067.

The vector analyzing powers have been measured for the $^{1}$H(d,γ) $^{3}$He and the $^{2}$H(p,γ) $^{3}$He reactions at E/sub x/ = 6 MeV. The results indicate the presence of channel spin (3/2) capture strength. An M1 strength amounting to between 1 and 8% of the cross section is able to explain the observations if a significant s = (3/2) component is included.

## 6513 Nuclear Properties And Reactions, A=6-19

**7719** **(BNL—35342) Role of giant resonances in heavy-ion radiative capture.** Sandorfi, A.M. (Brookhaven National Lab., Upton, NY (USA)). 1984. Contract AC02-76CH00016. 13p. (CONF-840906—18). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003603.

From Capture gamma-ray spectroscopy conference; Knoxville, TN, USA (10 Sep 1984).

The main features and physics of the radiative capture of heavy ions are reviewed. Data are discussed from three reactions: $^{12}C(^{12}C,\gamma)^{24}Mg$, $^{14}C(^{12}C,\gamma)^{26}Mg$, $^{12}C(^{16}O,\gamma)^{28}Si$. Excitation functions are given and discussed. 17 references.

**7720** **(INIS-mf—9184) Model-independent determination of resonance parameters for reactions involving only zero spin particles.** Basrak, Z. (Institut Rudjer Boskovic, Zagreb (Yugoslavia)); Auger, F.; Charles, P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physique Nucleaire); Tiereth, W.; Voit, H. (Erlangen-Nuernberg Univ., Erlangen (Germany, F.R.). Physikalisches Inst.). (Bielefeld Univ. (Germany, F.R.). Zentrum fuer Interdisziplinaere Forschung). [nd]. 5p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85780129.

The authors have calculated the energy dependence of the inelasticity parameter for the reaction $^{12}C(^{12}C,\alpha)^{20}Ne$ in the c.m.energy range from 5 to 6 MeV by means of a phase shift analysis.

**7721** (INIS-SU—228, pp 202-209) **Photonuclear experiments at intermediate energies.** Matthews, J.L. (Massachusetts Inst. of Tech., Cambridge (USA)). 1982. NTIS (US Sales Only), PC A13/MF A01. File Number TI84780397. (CONF-8106173—).

From 5. seminar on electromagnetic interactions of nuclei at low and medium energies; Moscow, USSR (15 Jun 1981).

Experimental study of photonuclear reactions (PR) on light nuclei at Esub(γ)> or approximately 140 MeV energies of incident photons are described. Different PR mechanisms in the region of Δ(1232) resonance are considered. Proton PR spectra and energy dependences of differential cross sections of $^{9}Be(\gamma, p)$, $^{12}C(\gamma, p)$, Cu(γ, p) type inclusive processes in the Esub(γ)=140-381 MeV energy range are given and compared. Methods for PR measurement are described. Degrees of meson freedom in $(\gamma, p_0)$ process with account of different PR mechanisms are considered. The whole picture of Pr expresiments for Esub(γ)=40-400 MeV energies on the example of the $^{16}O(\gamma, p_0)^{15}N$ reaction is discussed. It is concluded that there is no mechanism of the $(\gamma, N_0)$ reaction procedure which takes into account the measured cross sections in the Esub(γ)=40-400 MeV range of photon energies. Low-energy data on the $^{16}O(\gamma, p_0)$ reaction reasonably agree with a direct one-particle model of knocking out. If photon energies grow then two-particle processes become prevailing and calculations of meson exchange effects and excitation of Δ(1232)-resonance badly agree with the experimental data.

**7722** (Juel-Spez—255, pp 4) **States at Esub(x) = 16-22 MeV in $^{8}Be$ excited in the $^{12}C(d,^{6}Li)^{8}Be$ and $^{11}B(^{3}He,^{6}Li)^{8}Be$ reactions.** Jarczyk, L.; Strzalkowski, A.; Styczen, B.; Berg, G.P.A.; Brinkmoeller, B.; Hlawatsch, G.; Magiera, A.; Meissburger, J.; Oelert, W.; Prashun, D. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

**7723** (Juel-Spez—255, pp 11) **Observation of the 1.6 MeV level in $^{9}B$.** Djaloeis, A.; Paic, G.; Antolkovic, B. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

**7724** (Juel-Spez—255, pp 12) **Relative contribution of α-particle and $^{4}H$-like fragment transfers in $^{11}B + ^{3}He$ systems.** Jarczyk, L.; Strzalkowski, A.; Styczen, B.; Berg, G.P.A.; Brinkmoeller, B.; Hlawatsch, G.; Magiera, A.; Meissburger, J.; Oelert, W.; Prasuhn, D. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

**7725** (Juel-Spez—255, pp 13) **High lying T=3/2 analog states in $^{13}C$ via the $^{14}C(^{3}He,\alpha)^{13}C$ reaction.** Roemer, J.G.M.; Berg, G.P.A.; Brinkmoeller, B.; Hlawatsch, G.; Magiera, A.; Meissburger, J.; Oelert, W.; Paul, D.; Prasuhn, D.; Rossen, P. von. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

**7726** (Juel-Spez—255, pp 94-95) **Theoretical analysis of the proton decay of electroexcited carbon.** Co', G.; Krewald, S. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

**7727** (Juel-Spez—255, pp 95-96) **Theoretical description of electron scattering coincidence experiments.** Co', G.; Krewald, S. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

**7728** **Kinematically complete measurement of the $(\pi,\pi(p)$ reaction on $^{12}C$ at 220 MeV.** Faucett, J.A.; Wood, B.E.; McDaniels, D.K.; Gram, P.A.M.; Hamm, M.E.; Oothoudt, M.A.; Goulding, C.A.; Swenson, L.W.; Krane, K.S.; Stetz, A.W.; Plendl, H.S.; Norton, J.; Funsten, H.; Joyce, D. (University of Oregon, Eugene, Oregon 97403). *Physical Review* [*Section*] *C: Nuclear Physics;* **30**: No. 5, 1622-1631(Nov 1984).

The $^{12}C(\pi^{+-},\pi^{+-}p)$ reactions were studied at T/sub π/ = 220 MeV. The final particles were detected both separately and in coincidence and their momenta were measured. Calculation of the excitation energy of the residual nucleus allowed clear separation of events where an outer proton was removed. The data provide detailed evidence confirming the quasielastic picture of pion knockout reactions. Evidence for this derives from the agreement between the peak energies found in the coincidence spectra and those found in inclusive spectra, from analysis of angular distributions, and from the location of peaks found in missing mass spectra. The coincidence cross section is found to account for about half of the $(\pi^{+},\pi^{+\prime})$ reaction, and about half of this in turn corresponds to quasifree knockout of the outer shell protons. Secondary processes in the $(\pi^{-},\pi^{-}p)$ reaction are found to play a much more important role than in the $(\pi^{+},\pi^{+}p)$ reaction.

**7729** **Pion scattering from C and Ca at 800 MeV/c.** Marlow, D.; Barnes, P.D.; Colella, N.J.; Dytman, S.A.; Eisenstein, R.A.; Grace, R.; Pile, P.; Takeutchi, F.; Wharton, W.R.; Bart, S.; Hancock, D.; Hackenberg, R.; Hungerford, E.; Mayes, W.; Pinsky, L.; Williams, T.; Chrien, R.; Palevsky, H.; Sutter, R. (Carnegie-Mellon University, Pittsburgh, Pennsylvania 15213). *Physical Review* [*Section*] *C: Nuclear Physics;* **30**: No. 5, 1662-1670(Nov 1984).

Results from $\pi^{+-}$ elastic and inelastic scattering from $^{12}C$ and $^{40}Ca$ are reported. The data were all taken at an incident momentum of 800 MeV/c over an angular range from 4° to 38°. The elastic data are compared to first-order optical model calculations in momentum space; qualitative agreement is obtained. The inelastic data (from $^{12}C$ only) are compared to distorted-wave Born approximation calculations, and reasonable agreement is found if realistic inelastic transition densities are used.

7730 **Resonant structures in the $^{16}O(^{16}O,^{12}C)^{20}$ Ne reaction.** Kond, Y.; Tamura, T. (Department of Physics, University of Texas, Austin, Texas 78712). *Physical Review [Section] C: Nuclear Physics;* **30**: No. 1, 97-106(Jul 1984).

Formulation is made of an exact finite-range distorted-wave Born approximation for the case in which the distorting potentials depend on the total angular momentum J. The general formula thus derived is then simplified for the cases in which the spins of the projectile, target, and ejectile are zero. This simplified form of the new exact finite-range distorted-wave Born approximation formula is applied to the analyses of the resonant structures seen in the $^{16}O(^{16}O,^{12}C)^{20}$ Ne$(4_1^+)$ reaction, and it is found that good fits to data are obtained. It is also shown that the mechanism embodied in the band crossing model plays an essential role in achieving these good fits. A detailed discussion concerning the absolute magnitude of the distorted-wave Born approximation cross sections is also presented, based on recent calculations which use the cluster model.

7731 **Magnetic multipole excitations in $^{12}C$ by inelastic electron scattering.** Hicks, R.S.; Flanz, J.B.; Lindgren, R.A.; Peterson, G.A.; Fagg, L.W.; Millener, D.J. (University of Massachusetts, Amherst, Massachusetts 01003). *Physical Review [Section] C: Nuclear Physics;* **30**: No. 1, 1-13(Jul 1984).

Magnetic excitations in $^{12}C$ have been measured by inelastic electron scattering at backward scattering angles for momentum transfers between q = 0.5 and 3.3 $fm^{-1}$. Data for M1, M2, M3, and M4 transitions are compared to shell model calculations. In general, the excitation energies are reasonably predicted, as are the momentum transfer dependences of the form factors. However, the form factor magnitudes often exceed measurements by factors of more than 2. Candidates for $2^-$ states are seen at excitation energies of 18.2 and 22.7 MeV. It is shown how structure effects may reduce estimates of isospin mixing matrix elements from $(\pi,\pi')$ ratios.

7732 **Breakup of $^{16}O$ and $^{20}Ne$ at 9 MeV/nucleon.** Rae, W.D.M.; Cole, A.J.; Harvey, B.G.; Stokstad, R.G. (Nuclear Physics Laboratory, Oxford, England and Nuclear Science Division, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Physical Review [Section] C: Nuclear Physics;* **30**: No. 1, 158-168(Jul 1984).

A high resolution study of the breakup of $^{16}O$ and $^{20}Ne$ has been made at 9 MeV per nucleon. The experimental configuration preferentially detects sequential breakup events. The dominant source of $\alpha$-$^{12}C$ and $\alpha$-$^{16}O$ coincidence events is the decay of excited states in $^{16}O$ and $^{20}Ne$, respectively. The experimental technique and the reaction mechanism leading to sequential breakup are discussed.

## 6514 Nuclear Properties And Reactions, A=20-38

*REFER ALSO TO CITATION(S) 6514107830*

7733 (Juel-Spez—255, pp 5-6) **Reaction mechanism of the $^{22}Ne(d,^6Li)^{18}O$ reaction.** Oelert, W.; Palla, G. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

7734 (Juel-Spez—255, pp 7) **Excitation of Ksup($\pi$) = $2^-$ band states in sup(20,22)Ne via the (d,$^6$Li) reaction.** Palla, G.; Oelert, W. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

7735 (Juel-Spez—255, pp 24) **Search for nuclear structure effects in continuous spectra.** Seniwongse, G.; Machner, H.; Jahn, P.; Nolte, M.; Rogge, M.; Turek, P. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

7736 (Juel-Spez—255, pp 78-79) **Spin dependence of the HFB-mean field.** Gruemmer, F.; Schmid, K.W. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

7737 (Juel-Spez—255, pp 102-103) **ATDHF calculation on the $^4$He-$^{16}O$ system.** Provoost, D.; Gruemmer, F.; Goeke, K. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

7738 **$^{36}S(d,p)^{37}S$ and /sup 34,36/S(d,$^3$He)/sup 33,3/ $^5$P reactions.** Thorn, C.E.; Olness, J.W.; Warburton, E.K.; Raman, S. (Brookhaven National Laboratory, Upton, New York 11973). *Physical Review [Section] C: Nuclear Physics;* **30**: No. 5, 1442-1453(Nov 1984).

The $^{36}S(d,p)^{37}S$ reaction was studied at E/sub d/ = 25 MeV with an enriched $^{36}S$ target (81.1%) and momentum analysis of the protons. Twenty-six groups were identified with levels in $^{37}S$. Excitation energies were obtained with an uncertainty of < or $\approx$3 keV and angular distributions yielded l and S values for the transfer reaction. Comparison is made to local systematics and the l = 1 strength is also compared to recent (n,$\gamma$) results. The /sup 34,36/S(d,$^3$He)/sup 33,3/ $^5$P reactions were also studied. A mass excess for $^{35}P$ of -24854(5) keV was obtained. (d,$^3$He) proton pickup strength was observed to four states of $^{35}P$ and seven states of $^{33}P$. These results are compared to predictions of Wildenthal.

7739 **Beta-delayed two-proton decays of $^{22}Al$ and $^{26}P$.** Cable, M.D.; Honkanen, J.; Schloemer, E.C.; Ahmed, M.; Reiff, J.E.; Zhou, Z.Y.; Cerny, J. (Department of Chemistry and Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Physical Review [Section] C: Nuclear Physics;* **30**: No. 4, 1276-1285(Oct 1984). Contract AC03-76SF00098.

Beta-delayed two-proton radioactivity has been observed for the two nuclei $^{22}Al$ and $^{26}P$. Proton-proton coincidence experiments performed at small and large angles show that the dominant two-proton emission mechanism is a sequential process. Decay schemes have been determined for each isotope.

7740 **Measurement of nuclear potentials from fusion excitation functions.** Birkelund, J.R.; Huizenga, J.R. (Nuclear Structure Research Laboratory and Departments of Chemistry and Physics, University of Rochester, Rochester, New York 14627). *Physical Review [Section] C: Nuclear Physics;* **30**: No. 1, 401-402(Jul 1984).

Difficulties associated with the determination of the nuclear potential at distances inside the fusion barrier radius are discussed. The critical distance model analysis of fusion excitation functions at high bombarding energies does not give a model independent measurement of the internuclear potential at small separations of interacting heavy nuclei.

7741 **Potential models and resonances in the $^{16}O+$ $^{28}Si$ system.** Kobos, A.M.; Satchler, G.R. (Nuclear Physics Laboratory, Oxford University, Oxford, England). *Physical Review [Section] C: Nuclear Physics;* **30**: No. 1, 403-404(Jul 1984).

Two recent papers have given optical potential descriptions for the elastic scattering of the $^{16}O+$ $^{28}Si$ system at energies near the Coulomb barrier, both of which manifest partial-wave resonances. Our comment is that there is at least one other potential that reproduces the measurements but which does not result in such resonances.

## 6515 Nuclear Properties And Reactions, A=39-58

7742 **(BNL—35336) Recent results from proton capture to giant resonances built on highly-excited states.** Dowell, D.H. (Brookhaven National Lab., Upton, NY (USA)). 1984. Contract AC02-76CH00016. 16p. (CONF-840906—17). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003211.

From Capture gamma-ray spectroscopy conference; Knoxville, TN, USA (10 Sep 1984).

New measurements of the (p,γ) reaction on natural targets of K and Ca at intermediate proton energies (E/sub p/ = 11 to 36 MeV) reveal excitation functions that are dominated by excited-state giant dipole resonances (ESGDR's) built upon single-particle states in $^{40}$Ca and $^{41}$Sc. These ESGDR's all peak near E/sub γ/ = 20 MeV and have widths which increase monotonically with the final state's excitation energy. The integrated, inverse (γ,P$_0$) cross sections are shown to be proportional to the known single-particle spectroscopic strengths indicating a semi-direct mechanism for the capture process. 12 references, 13 figures.

7743 (Juel-Spez—255, pp 1) **Investigation of high lying M1 states in $^{40}$Ca(p,p') at Esub(p) = 45 MeV.** Brinkmoeller, B.; Paul, D.; Sondermann, G.; Berg, G.P.A.; Hlawatsch, G.; Magiera, A.; Meissburger, J.; Roemer, J.; Tain, J.L. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

7744 (Juel-Spez—255, pp 2) **Excitation of 1$^+$ states in $^{58}$Ni by inelastic proton scattering at 45 MeV.** Berg, G.P.A.; Meissburger, J.; Paul, D.; Roemer, J.G.M.; Tain, J.L.; Gaul, G.; Sondermann, G. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

7745 (Juel-Spez—255, pp 21) **Three-body versus four-body contributions in α break-up on $^{58}$Ni.** Siebert, R.; Morsch, H.P.; Decowski, P.; Rogge, M.; Turek, P. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

7746 (Juel-Spez—255, pp 23-24) **Light particle correlations.** Machner, H. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

7747 (Juel-Spez—255, pp 30-31) **Simulation experiments for planetary spectroscopy: Neutron-induced gamma-rays from thin targets.** Englert, P.; Brueckner, J.; Waenke, H.; Reedy, R.C. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

7748 **Collective bands in $^{75}$Kr.** Garcia Bermudez, G.; Baktash, C.; Lister, C.J. (Department of Physics, Brookhaven National Laboratory, Upton, New York 11973). *Physical Review* [*Section*] *C: Nuclear Physics;* **30**: No. 4, 1208-1213(Oct 1984).

Multiple-particle γ-ray coincidence techniques have been used to study the high spin structure of $^{78}$Kr excited through the $^{40}$Ca($^{39}$K,3pn) reaction at E = 120 MeV. From γ-ray angular distribution and γ-γ coincidence experiments two ΔI = 1 bands were found. These bands are interpreted as being built on the (3/2)$^-$[301] and (5/2)$^+$[422] Nilsson orbitals, which have been identified in adjacent odd-A nuclei in this region.

7749 **Symmetric splitting of very light systems.** Grotowski, K.; Majka, Z.; Planeta, R.; Szczodrak, M.; Chan, Y.; Guarino, G.; Moretto, L.G.; Morrissey, D.J.; Sobotka, L.G.; Stokstad, R.G.; Tserruya, I.; Wald, S.; Wozniak, G.J. (Institute of Physics, Jagellonian University, Reymonta 4, Cracow, Poland). *Physical Review* [*Section*] *C: Nuclear Physics;* **30**: No. 4, 1214-1222(Oct 1984). Contract AC03-76SF00098.

Inclusive and coincidence measurements have been performed to study symmetric products from the reactions 74—186 MeV $^{12}$C+ $^{40}$Ca, 141 MeV $^{9}$Be+ $^{40}$Ca, and 153 MeV $^{6}$Li+ $^{40}$Ca. The binary decay of the composite system has been verified. Energy spectra, angular distributions, and fragment correlations are presented. The total kinetic energies for the symmetric products from these very light composite systems are compared to liquid drop model calculations and fission systematics.

7750 **Statistical properties of 5/2 + resonances in $^{51}$Mn.** Whatley, K.M.; Bilpuch, E.G.; Mitchell, G.E.; Shriner, J.F. Jr.; Westerfeldt, C.R. (Duke Univ., Durham, NC). *Journal of Physics G: Nuclear Physics;* **9**: 1527-1536(1983). Contract AC05-76ER01067;AS05-76ER03624.

A high-resolution study of proton inelastic decay from 5/2 + resonances in $^{51}$Mn has been performed in the energy range E/sub p/ = 3.26 to 4.28 MeV. Magnitudes and relative signs were determined for three decay channels for 38 5/2 + resonances in $^{51}$Mn. Very large amplitude and width correlations were observed.

## 6516 Nuclear Properties And Reactions, A=59-89

7751 **(IC—84/18) Inelastic electron scattering form factors involving the second excited 2$^+$ levels in the nuclei $^{48}$Ti and $^{50}$Cr.** Mukherjee, G.; Sharma, S.K. (International Centre for Theoretical Physics, Trieste (Italy)). Mar 1984. 13p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700138.

A microscopic description of the recent data on the Coulomb form factors for the Osub(gnd)$^+$→2$_4^+$ transitions in the nuclei $^{48}$Ti and $^{50}$Cr is attempted in terms of the prolate and oblate intrinsic states resulting from realistic effective interactions operating in the 2p-1f shell. The results for the higher momentum-transfer region show dramatic improvements compared to the form factor estimates obtained in some recent shell model calculations involving the fsub(7/2)sup(n)+fsub(7/2)sup(n-1)psub(3/2) configurations.

7752 (Juel-Spez—255, pp 8-10) **Proton-hole states in Co-isotopes observed via the (d,$^3$He) reaction.** Marinov, A.; Gopal, S.; Mooy, R.B.M.; Glaudemans, P.W.M.; Brant, S.; Paar, V.; Vouk, M.; Lopac, V.; Berg, G.P.A.; Bojowald, J. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

7753 (Juel-Spez—255, pp 31-32) **Measurement and hybrid model analysis of integral excitation functions for light particle induced reactions.** Michel, R.; Galas, M.; Pfeiffer, F.; Stueck, R. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

7754 (Juel-Spez—255, pp 33) **Study of $^{75}$Se by neutron capture and SU(3) - SU(5) transition in quadrupole-phonon representation.** Tokunaga, Y.; Seyfarth, H.; Schult, O.W.B.; Brant, S.; Paar, V.; Vretenar, D.; Boerner, H.G.; Barreau, G.; Faust, H.; Schreckenbach, K. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

**7755** (Juel-Spez—255, pp 34) **$^{75}$Se(n,γ)$^{76}$Se reaction and the low-lying level structure of $^{76}$Se.** Tokunaga, Y.; Seyfarth, H.; Schulte, O.W.B.; Boerner, H.G.; Barreau, G.; Brissot, R.; Kaup, U.; Moenkemeyer, C.; Hofmeyr, C. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

**7756** (Juel-Spez—255, pp 35) **Low-lying levels of $^{77}$Se studied through thermal neutron capture and evidence for a new term in the E2 operator of TQM(IBM).** Tokunaga, Y.; Seyfarth, H.; Schult, O.W.B.; Boerner, H.G.; Barreau, G.; Faust, H.; Schreckenbach, K.; Brant, S.; Paar, V.; Vouk, M. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

**7757** (Juel-Spez—255, pp 66-67) **Nature of the $1^+$ state at 3.48 MeV in $^{88}$Sr.** Conci, C.; Speth, J. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

**7758** **α-particle D-state components from (d,α) analyzing powers.** Karp, B.C.; Ludwig, E.J.; Thompson, W.J.; Santos, F.D. (University of North Carolina, Chapel Hill, North Carolina 27514 and Triangle Universities Nuclear Laboratory, Durham, North Carolina 27706). *Physical Review Letters;* 53: No. 17, 1619-1622(22 Oct 1984). Contract AS05-76ER02408.

A D-state component in the α particle has been extracted from angular distributions of tensor analyzing powers for $^{89}$Y(d,$\alpha_0$)$^{87}$Sr at 9, 12, and 16 MeV. Exact finite-range distorted-wave Born approximation analyses including the effects of L and J mixing have been performed. The D-state parameter $D_2$, closely related to the asymptotic D- to S-state ratio for d-d relative motion in the α particle, requires a value of $D_2 = -0.3 +- 0.1$ fm$^2$ in order to fit the tensor analyzing power data.

## 6517 Nuclear Properties And Reactions, A=90-149

**7759** **(CONF-840906—14) Crystal ball studies of giant resonance gamma decay.** Beene, J.R.; Bertrand, F.E.; Halbert, M.L. (Oak Ridge National Lab., TN (USA)). 1984. Contract AC05-84OR21400. 14p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85003543.

From Capture gamma-ray spectroscopy conference; Knoxville, TN, USA (10 Sep 1984).

We have carried out coincidence experiments to investigate the photon and neutron emission from the giant resonance region in $^{208}$Pb and $^{90}$Zr using the ORNL Spin Spectrometer, a 72-segment NaI detector system. States in $^{208}$Pb and $^{90}$Zr were excited by inelastic scattering of 380-MeV $^{17}$O. We have determined the total gamma-decay probability, the ground-state gamma branching ratio, and the branching ratios to a number of low-lying states as a function of excitation energy in $^{208}$Pb to ~ 15 MeV. Especially interesting observations include the absence of a significant branch from the giant quadrupole resonance to the $3^-$ state at 2.6 MeV, a strong branch from this resonance to a $3^-$ state at 4.9 MeV, and the dominance of decays to various $1^-$ states at 5 to 7 MeV from the region around 14 MeV of excitation (EO resonance). Comparable but less complete data were also obtained on $^{90}$Zr. 14 references.

**7760** **(GSI—84-36-Prepr.) $^{92}$Mo+$^{92}$Mo reaction at 14.7 MeV/u: Approaching the limits of the classical deep-inelastic process.** Gralla, S.; Bock, R.; Gobbi, A.; Hildenbrand, K.D.; Kuzminski, J.; Lynen, U.; Mueller, W.F.J.; Olmi, A.; Petrovici, M.; Sann, H. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Jun 1984. 13p. NTIS (US Sales Only), PC A02/MF A01. File Number DE84752336.

The triple-differential cross section d$^3$sigma/dAxdTKExdtheta of binary exit channels in the reaction $^{92}$Mo+$^{92}$Mo has been measured at an energy of 14.7 MeV/u. Energy relaxation is achieved with an energy loss of about 500 MeV, corresponding to temperatures in the fragments of up to 5 MeV; the primary mass distribution tends to spread over the full range of mass asymmetries, indicating a loss of the initial target and projectile identity and hence the disappearance of an essential feature of the deep-inelastic process.

**7761** **(INS—468) Widths of isovector monopole resonances.** Adachi, S.; Auerbach, N. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). May 1983. 20p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700140.

The widths of the isovector monopole ΔTsub(z) = 1 component in $^{208}$Tl, $^{140}$La, $^{120}$In and $^{90}$Y are evaluated within the self-consistent Hartree-Fock + charge-exchange RPA using the Skyrme interaction. The coupling of 1p-1h states to 2p-2h configurations is microscopically calculated. The results are compared with those of recent pion charge-exchange reactions.

**7762** (Juel-Spez—255, pp 3) **Identification of the second $13/2^+$ state of the octupole multiplet in $^{143}$Nd.** Trache, L.; Wrzesinsky, J.; Wesselborg, C.; Clauberg, A.; Reinhardt, R.; Brentano, P. von; Zell, K.O.; Morris, C.; Berg, G.P.A.; Brinkmoeller, B. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

**7763** (Juel-Spez—255, pp 15-16) **$^{90}$Zr($^3$He,t)$^{90}$Nb reaction and the Gamow-Teller strength.** Tain, J.L.; Berg, G.P.A.; Brinkmoeller, B.; Hlawatsch, G.; Magiera, A.; Meissburger, J.; Oelert, W.; Roemer, J.G.M.; Sondermann, G. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

**7764** (Juel-Spez—255, pp 17-19) **Study of the ($^3$He,t) charge exchange reaction at Esub($^3$He) = 135 MeV.** Morsch, H.P.; Decowski, P.; Berg, G.P.A.; Tain, J.L.; Rogge, M.; Turek, P.; Zemlo, L.; Meissburger, J.; Roemer, J.G.M. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

**7765** (Juel-Spez—255, pp 36-37) **Rotation-like $5/2^+$ bands in odd-mass A proportional 100 nuclei as coherent-state structures of quadrupole phonons in PTQM.** Meyer, R.A.; Paar, V.; Brant, S. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

**7766** (Juel-Spez—255, pp 37) **New excited $O^+$ state in $^{100}$Zr.** Sistemich, K.; Petry, R.F.; Hill, J.C.; Wohn, F.K.; Gill, R.L.; Mach, H.; Piotrowski, A. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

**7767** (Juel-Spez—255, pp 38) **Angular correlation measurements on $^{100}$Mo.** Menzen, G.; Lhersonneau, G.; Kohl, P.; Lawin, H.; Sistemich, K.; Seo, T.; Gietz, H.; Kaffrell, N. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

**7768** (Juel-Spez—255, pp 39) **Nanosecond-half-lives of nuclear levels near A = 100.** Lhersonneau, G.; Seo, T.; Lawin, H.; Menzen, G.; Sistemich, K. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

7769 (Juel-Spez—255, pp 40) **Deformation of $_{43}{}^{103}Mo_{61}$.** Seo, T.; Lhersonneau, G.; Lawin, H.; Meyer, R.A.; Menzen, G.; Sistemich, K. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

7770 (Juel-Spez—255, pp 41) **Band structures in $_{41}{}^{101}Nb_{60}$.** Schmitt, A.M.; Kaffrell, N.; Tittel, G.; Trautmann, N.; Ahrens, H.; Bocquet, J.P.; Seo, T.; Lawin, H.; Lhersonneau, G.; Meyer, R.A. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

7771 (Juel-Spez—255, pp 42) **Rotational bands in $_{41}{}^{103}Nb_{62}$.** Seo, T.; Lhersonneau, G.; Meyer, R.A.; Shizuma, K.; Sistemich, K.; Schmitt, A.M.; Kaffrell, N.; Tittel, G.; Trautmann, N.; Ahrens, H. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

7772 (Juel-Spez—255, pp 43-44) **Level scheme of $^{134}Cs$.** Bogdanovic, M.; Seyfarth, H. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

7773 (Juel-Spez—255, pp 45-46) **In-beam study of the odd-odd nuclei in $^{134}La$ and $^{136}La$.** Morek, T.; Beuscher, H.; Bochev, B.; Kutsarova, T.; Lieder, R.M.; Mueller-Veggian, M.; Neskakis, A. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

7774 (Juel-Spez—255, pp 47) **Interaction between neutron particle-hole and octupole core coupled states in N = 83 nuclei.** Meyer, R.A.; Heyde, K.; Isacker, P. van; Waroquier, M.; Moreau, J.; Wood, J.L. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

7775 (Juel-Spez—255, pp 48-49) **$10^+$ states of $\nu$hsub(11/2)$^{-2}$ and $\pi$hsub(11/2)$^2$ character in the N = 80 nucleus $^{142}Sm$.** Lach, M.; Styczen, J.; Blomqvist, J.; Beuscher, H.; Kleinheinz, P. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

7776 (Juel-Spez—255, pp 50-51) **High-lying yrast states in $^{145}Eu$ and its mass.** Rubio, B.; Julin, R.; Ercan, A.; Kleinheinz, P.; Tain, J.L.; Berg, G.P.A.; Hlawatsch, G.; Meissburger, J.; Paul, D.; Roemer, J.G. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

7777 (Juel-Spez—255, pp 52-53) **Study of particle-hole multipletts in $^{146}Gd$ through ($\alpha$,2n) in-beam measurements.** Yates, S.W.; Kleinheinz, P.; Julin, R.; Stoeffl, W.; Henry, E.; Mann, L.; Decman, D.; Blomqvist, J. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

7778 (Juel-Spez—255, pp 54-55) **Single- and double octupole excitations in $^{148}Gd$.** Lunardi, S.; Kleinheinz, P.; Piiparinen, M.; Ogawa, M.; Blomqvist, J. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

7779 (Juel-Spez—255, pp 64-65) **Quasiparticle RPA calculations for $_{64}{}^{146}Gd_{82}$ with effective forces including meson exchange potentials.** Conci, C.; Klemt, V.; Speth, J. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

7780 (Juel-Spez—255, pp 65-66) **Spectroscopic study of low-energy states of the N=82 isotones $_{60}{}^{142}Nd$, $_{62}{}^{144}Sm$, $_{66}{}^{148}Dy$ and $_{68}{}^{150}Er$ in the framework of the QRPA-theory.** Conci, C.; Klemt, V.; Speth, J. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

7781 (Juel-Spez—255, pp 69-70) **Isobar-hole and 2p2h effects on the M1-strength in $^{90}Zr$ and $^{208}Pb$.** Cha, D.; Schwesinger, B.; Wambach, J.; Speth, J. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

7782 (Juel-Spez—255, pp 70-71) **Isobar-hole and 2p2h effects on the M2-strength in $^{90}Zr$ and $^{208}Pb$.** Cha, D.; Schwesinger, B.; Wambach, J.; Speth, J. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

7783 (Juel-Spez—255, pp 72-73) **Isobar-hole and 2p2h effects on the spin-dipole strength in $^{90}Zr$ and $^{208}Pb$.** Cha, D.; Schwesinger, B.; Wambach, J.; Speth, J. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

7784 (Juel-Spez—255, pp 73-75) **Isobar-hole and 2p2h effects on the Gamow-Teller strength in $^{90}Zr$ and $^{208}Pb$.** Cha, D.; Schwesinger, B.; Wambach, J.; Speth, J. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

7785 (Juel-Spez—255, pp 76-77) **Description of odd-even nuclei in the A=130 region.** Hammaren, E.; Schmid, K.W.; Gruemmer, F. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

7786 (Juel-Spez—255, pp 77-78) **Description of even-even nuclei in the A=130 region.** Schmid, K.W.; Hammaren, E.; Gruemmer, F. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

7787 (Juel-Spez—255, pp 84) **High energy proton induced fission of rare earth nuclei.** Nemeth, J.; Irvine, J.M. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

7788 (Juel-Spez—255, pp 85-86) **Fragmentation of nuclear strength distributions by two-particle two-hole excitations.** Wambach, J.; Schwesinger, B. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

7789 (Juel-Spez—255, pp 98-99) **Calculation of the background below Gamow-Teller resonances.** Osterfeld, F.; Schulte, A. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

7790 (Juel-Spez—255, pp 99-100) **Calculation of the background below the giant dipole ($\Delta L=1$)-resonance.** Osterfeld, F.; Schulte, A. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

7791 **(KIYI—83-19) Low-lying collective state properties of the even-even Cd and Pd nuclei.** Vishnevskij, I.N.; Zheltonozhskij, V.A.; Yrishin, V.V. (AN Ukrainskoj SSR, Kiev. Inst. Yadernykh Issledovanij). 1983. 29p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. File Number DE84703233.

An analysis is carried out for experimental data on energies of the low-lying levels of even-even sup(104-114)Cd and sup(100-110)Pd nuclei and probabilities of its discharge on different collective models: vibrational, interacting bosons, nonaxial nucleus, rotator with variable inertia moment. Results are given for level energy calculations and ratio of E2-transition probabilities on interacting bosons models (IBM) and Davydov-Chaban, and mixing parameters of multipole orders on IBM. It is shown that IBM reflects the most totally properties of the low-lying even-even vibrational nuclei shown that IBM reflects the most tota.

7792 **(PNL-SA—12343) Delayed neutron studies at isotope separators.** Reeder, P.L. (Pacific Northwest Lab., Richland, WA (USA)). Jun 1984. Contract AC06-76RL01830. 38p. (CONF-8406149—4). NTIS, PC A03/MF A01; GPO Dep. File Number DE85003105.

From TRIUMF-ISOL workshop; Montreal, Canada (13 Jun 1984).

Experimental studies of delayed neutron precursors produced at on-line isotope separator facilities are briefly reviewed. These studies provide information on beta strength functions above the neutron binding energy and other nuclear structure properties for nuclides far from the line of beta stability. In addition, delayed neutron decay can be a unique signature for identifying new isotopes. Examples are given of recent experiments with both fission product and nonfission product precursors. Several experiments are proposed for delayed neutron precursors in the poorly known mass region of 20 to 85. Some preliminary ideas for an Element Selective Laser Ionization (ESLI) source are presented. 29 references, 23 figures.

7793 **(UTTAC—46) Analyzing powers for (p,t) transitions to the first-excited $2^+$ states of medium-mass nuclei and nuclear collective motions.** Nagano, K.; Aoki, Y.; Kishimoto, T.; Yagi, K. (Tsukuba Univ., Sakura, Ibaraki (Japan). Tandem Accelerator Center). 1983. 84p. NTIS (US Sales Only), PC A05/MF A01. File Number DE85700150.

Vector analyzing powers A(theta) and differential cross sections $\sigma$(theta) have been measured, with the use of a polarized proton beam of 22.0 MeV and a magnetic spectrograph, for (p,t) reactions leading to the first-excited $2^+$ ($2_1^+$) states of the following eighteen nuclei of N = 50 - 82: sup(92,94,96)Mo, sup(98,100,102)Ru, sup(102,104,106,108)Pd, sup(110,112,114)Cd, $^{116}$Sn, sup(120,126,128)Te, and $^{136}$Ba. In addition A(theta) and $\sigma$(theta) for sup(104,110)Pd(p,t) sup(102,108) Pd(0sub(g)$^+$,$2_1^+$) transitions have been measured at Esub(p) = 52.2 MeV. The experimental results are analyzed in terms of the first- and second-order DWBA including both inelastic two-step processes and sequential transfer (p,d)(d,t) two-step processes. Interference effect between the direct method for calculating the (p,d)(d,t) spectroscopic amplitudes has been developed so as to take into account the ground-state correlation in odd-A nuclei. The nuclear-structure wave functions are constructed under the boson expansion method and the quasiparticle random phase approximation (qp RPA) method by using the monopole-pairing, quadrupole-pairing, and QQ forces. The characteristic features of the experimental A(theta) and $\sigma$(theta) are better explained in terms of the boson expansion method than in terms of the qp RPA. Dependence of the (p,t) analyzing powers on the static electric quadrupole moment of the $2_1^+$ state is found to be strong because of the reorientation (anharmonic) effect in the $2_1^+$ yiedls $2_1^+$ transfer process.

7794 **Evidence for collective behavior in $^{128}$Ce from lifetime measurements.** Wells, J.C.; Johnson, N.R.; Hattula, J.; Fewell, M.P.; Haenni, D.R.; Lee, I.Y.; McGowan, F.K.; Johnson, J.W.; Riedinger, L.L. (Tennessee Technological University, Cookeville, Tennessee 38505 and Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physical Review [Section] C: Nuclear Physics;* **30**: No. 5, 1532-1537(Nov 1984).

Lifetimes in the yrast sequence of $^{128}$Ce have been measured following the reaction $^{92}$Zr($^{40}$Ar, 4n) induced by 159-MeV $^{40}$Ar ions. A Doppler-shift recoil-distance device was utilized inside a large NaI detector where the latter provided total $\gamma$-ray decay energy selection for these measurements. The B(E2) values deduced for the $2^+$ through $14^+$ states indicate that in the ground band $^{128}$Ce conforms much more closely to rigid-rotor behavior than do the heavier cerium isotopes, and that in the s band the shape parameters remain in the collective sector $-60^\circ<\gamma<0^\circ$, as predicted by cranked self-consistent theory.

7795 **Single-particle levels in the doubly magic $^{132}$Sn and $^{100}$Sn nuclei.** Leander, G.A.; Dudek, J.; Nazarewicz, W.; Nix, J.R.; Quentin, P. (UNISOR, Oak Ridge Associated Universities, Oak Ridge, Tennessee 37830). *Physical Review [Section] C: Nuclear Physics;* **30**: No. 1, 416-419(Jul 1984).

The observed single-particle energies in $^{132}$Sn are compared with three current models. For each of the three models the deviations from experiment in $^{132}$Sn are found to be correlated with the corresponding deviations in $^{208}$Pb. Assuming a similar relation between $^{100}$Sn and $^{56}$Ni, the proton binding energy of $^{100}$Sn is predicted to be about 3 MeV.

7796 **Relativistic description of (p,n) reactions to the isobaric analog state.** Clark, B.C.; Hama, S.; Sugarbaker, E.; Franey, M.A.; Mercer, R.L.; Ray, L.; Hoffmann, G.W.; Serot, B.D. (Department of Physics, The Ohio State University, Columbus, Ohio 43210). *Physical Review [Section] C: Nuclear Physics;* **30**: No. 1, 314-321(Jul 1984).

Lorentz vector and scalar, isovector and isoscalar proton-nucleus optical potentials are obtained from invariant nucleon-nucleon amplitudes using a relativistic impulse approximation. Cross sections, analyzing powers, and spin rotation functions for $^{90}$Zr(p,p) and the $^{90}$Zr(p,n)$^{90}$Nb (isobaric analog state) reaction at 160 and 500 MeV are calculated using a relativistic generalization of the Lane equations. These predictions are compared to nonrelativistic impulse approximation results and to experimental data at 160 MeV.

7797 **g factors of high spin states in /sup 154,155/Er and $^{157}$Yb and the nature of the neutron $(13/2)^+$ quasiparticle in transitional nuclei.** Rafailovich, M.H.; Kistner, O.C.; Sunyar, A.W.; Vajda, S.; Sprouse, G.D. (Brookhaven National Laboratory, Upton, New York 11973). *Physical Review [Section] C: Nuclear Physics;* **30**: No. 1, 169-174(Jul 1984). Contract AC02-76CH00016.

The g factors of the I/sup $\pi$/ = $11^-$ isomer in $^{154}$Er and I/sup $\pi$/ = $(13/2)^+$ isomers in $^{155}$Er and $^{157}$Yb were measured using the technique of time-dependent perturbed angular distributions. The value obtained for $^{154}$Er, g = +0.0154(12), indicates a predominant configuration of $\nu$[i/sub 13/2/,h/sub 9/2/]$_{10}^-$, $11^-$ for the

isomeric state. The results for $^{165}$Er and $^{167}$Yb, g = -0.085(5) and g = -0.116(12), respectively, are explained in terms of Pauli blocking of the $3^-$ core excitation component in the wave function of the $(13/2)^+$ state.

## 6518 Nuclear Properties And Reactions, A=150-189

*REFER ALSO TO CITATION(S) 6518107611, 7780, 7812*

**7798** **(BNL—35319) Tests of supersymmetries with the (n,γ) reaction.** Warner, D.D. (Brookhaven National Lab., Upton, NY (USA)). 1984. Contract AC02-76CH00016. 16p. (CONF-840906—15). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003206.

From Capture gamma-ray spectroscopy conference; Knoxville, TN, USA (10 Sep 1984).

The characteristics of the SU(3) and 0(6) boson-fermion symmetries stemming from a U(6/12) group structure are discussed and compared with recent results of (n,γ) studies in the W-Pt region. The nuclei $^{185}$W and $^{196}$Pt are shown to represent the best empirical examples of the SU(3) and O(6) limits, respectively, and it is also shown that the consistent Q formalism can be extended to the odd A Hamiltonian to describe the transition between these two limits. Preliminary comparisons with the low lying structure of the odd Os nuclei are presented. The question of the empirical evidence for supersymmetry in this region is also discussed. 23 references.

**7799** **(JINR-R—1-83-733) Associative production of particles with a large transverse momentum in $^{12}$C-$^{181}$Ta interactions at P=4,2 GeV/c per nuclei.** Gasparyan, A.P.; Mekhtiev, R.R.; Solov'ev, M.I.; Toneev, V.D. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1983. 4p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85700148.

In $^{12}$C-$^{181}$Ta interactions with carbon primary momentum of 4.2 GeV/c per nucleon the emission of energetic particles in the direction along the particle with a high transverse momentum psub(t) >- 1 GeV/c production is observed. The investigation has been performed with the help of the 2-meter propane bubble chamber with an internal tantalum target. The experimental distribution over the difference between azimuthal angles of a particle with a high Psub(t) and other particles also points to the kinematical compensation of fast particle emission in nucleus-nucleus collisions. The comparison of experimental data with cascade model predictions was made.

**7800** (Juel-Spez—255, pp 27) **Fast nucleon emission from heavy ion induced reactions.** Machner, H. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

**7801** (Juel-Spez—255, pp 29-30) **Mean angular momenta involved in the preequilibrium charged particle emission.** Bochev, B.; Kutsarova, T.; Lieder, R.M.; Didelez, J.P.; Morek, T. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

**7802** (Juel-Spez—255, pp 56) **Search for rotational band members in $^{152}$Eu.** Prokofjev, P.T.; Simonova, L.I.; Matthess, H.; Soramel-Stanco, F.; Styczen, J.; Ercan, A.; Kleinheinz, P. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

**7803** (Juel-Spez—255, pp 57) **Study of the band structure in the odd-odd nucleus $^{180}$Re.** Venkova, T.; Sletten, G.; Bochev, B.; Gast, W.; Kutsarova, T.; Lieder, R.M.; Morek, T. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

**7804** (Juel-Spez—255, pp 58-59) **Investigation of band structures and crossings in $^{181}$Os.** Lieder, R.M.; Neskakis, A.; Sletten, G.; Garrett, J.D. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

**7805** **Breakup-fusion calculations of continuum spectra of (h,p) and (h,d) reactions at E/sub h/ = 100 MeV.** Li, X.; Udagawa, T.; Tamura, T. (Department of Physics, University of Texas, Austin, Texas 78712). *Physical Review* [*Section*] *C: Nuclear Physics;* **30**: No. 4, 1349-1351(Oct 1984).

A breakup-fusion description is used to calculate continuum spectra of the $^{165}$Ho(h,p) and (h,d) reactions with an incident energy of 100 MeV. It is shown that the high energy part of the observed spectra up to the peak is fitted very well by the calculations, but that the lower energy part is somewhat underestimated. Possible mechanisms that are responsible for the additional lower energy part are discussed.

**7806** **Decay of $^{188}$Tl and observed shape coexistence in the bands of $^{188}$Hg.** Cole, J.D.; Hamilton, J.H.; Ramayya, A.V.; Lourens, W.; van Nooijen, B.; Kawakami, H.; Mink, L.A.; Spejewski, E.H.; Carter, H.K.; Mlekodaj, R.L.; Leander, G.A.; Riedinger, L.L.; Bingham, C.R.; Zganjar, E.F.; Wood, J.L.; Fink, R.W.; Toth, K.S.; Kern, B.D.; Sastry, K.S.R. (Vanderbilt University, Nashville, Tennessee 37325). *Physical Review* [*Section*] *C: Nuclear Physics;* **30**: No. 4, 1267-1275(Oct 1984).

The decay of the isotope $^{188}$Tl (T/sub 1/2/ = 71 +- 1 s) was studied via conversion-electron, gamma, gamma-gamma, and gamma-conversion-electron measurements. Levels of $^{188}$Hg were deduced. Two bands with quite different deformation were established. One band is built on a near spherical ground state and the other band is built on a well-deformed shape with an excited $0_2^+$ band head at 824.5 keV. The bands cross and coexist above and below the crossing point. Their crossing explains the unusual behavior of the moment of inertia of the yrast cascade.

**7807** **Mass and kinetic energy distributions in near-barrier fission of $^{182}$W.** Wilkins, B.D.; Back, B.B.; Gindler, J.E.; Glagola, B.G.; Kwiatkowski, K.; Zhou, S.H.; Viola V.E. Jr. (Chemistry Division, Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review* [*Section*] *C: Nuclear Physics;* **30**: No. 4, 1228-1232(Oct 1984). Contract W-31-109-ENG-38.

Mass and kinetic energy distributions have been measured for the fission of $^{182}$W at an excitation energy above the fission barrier E(-E/sub f/roughly-equal20 MeV. A primary motivation for these studies was to search for evidence of asymmetric mass division and anomalously low total kinetic energy release, as predicted by scission-point model calculations which include deformed (Strutinsky) shell effects. Double kinetic energy measurements of coincident fission fragments were performed, from which fragment mass distributions were derived. From the data it is concluded that at this excitation energy, liquid-drop behavior dominates the fission of $^{182}$W and any shell strength, if present, is less than 20 percent of full strength.

**7808** **Evidence for reduced neutron pairing correlations in $^{165}$Yb.** Schuck, C.; Bendjaballah, N.; Diamond, R.M.; Ellis-Akovali, Y.; Lindenberger, K.H.; Newton, J.O.; Stephens, F.S.; Garrett, J.D.; Herskind, B. (Lawrence Berkeley Lab., CA). *Physics Letters,* [*Section*] *B;* **142**: No. 4, 253-257(26 Jul 1984).

Three rotational sequences in $^{165}$Yb have been extended to high spins by using the $^{130}$Te($^{40}$Ar, 5n) and $^{150}$Nd($^{20}$Ne, 5n) reactions. Evidence is presented for a reduction of the neutron pairing correlations at the highest rotational frequencies ($\hbar\omega$>0.40 MeV), but no quantitative measure of this reduction can be made. There appears to be a conflict with the expectations of simple CSM calculations.

**7809** **$^{187}$Os(n,n') inelastic cross section at 34 keV.** Macklin, R.L.; Winters, R.R.; Hill, N.W.; Harvey, J.A. (Oak Ridge National Lab., TN). *Astrophysical Journal;* **274**: 408-413(1 Nov 1983).

A measurement of the $^{187}$Os inelastic neutron cross section to the 3/2$^-$ 9.75 keV excited state with 34 +- 2 keV incident neutrons gives 1.5 +- 0.2 barns. Pulsed neutron time of flight and a short anisotropic iron-aluminum filter allowed separation of the inelastic yield from the 1/2$^-$ ground-state elastic yield at 24 keV. The influence of the result on r-process galactic age calculations via the Re-Os decay chronometer is discussed, and the need for further theoretical calculations is emphasized.

## 6519 Nuclear Properties And Reactions, A=190-219

**7810** (Juel-Spez—255, pp 17) **Study of giant resonances in small angle $\alpha$ scattering experiments.** Morsch, H.P.; Decowski, P.; Rogge, M.; Turek, P.; Zemlo, L.; Berg, G.P.A.; Meissburger, J.; Roemer, J.G.M. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

**7811** (Juel-Spez—255, pp 25-26) **Study of the fragment-mass-distribution of $^4$He-induced fission.** Buttkewitz, A.; Duhm, H.H.; Strauss, W.; Machner, H. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

**7812** (Juel-Spez—255, pp 68-69) **Model to include 2p2h as well as 1$\Delta$1h states for the magnetic response of heavy nuclei.** Cha, D.; Schwesinger, B.; Wambach, J.; Speth, J. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

**7813** (Juel-Spez—255, pp 75) **Meson exchange current effects in heavy nuclei.** Dehesa, J.S.; Lallena, A.; Donnelly, T.W.; Krewald, S. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

**7814** (Juel-Spez—255, pp 87) **$\Delta$-isobar effects on M2-strength in $^{208}$Pb.** Cha, D.; Speth, J. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

**7815** (Juel-Spez—255, pp 96-97) **Microscopic calculation of the imaginary optical potential for $^{208}$Pb(p,p) at 14 MeV.** Dermawan, H.; Madsen, V.A.; Osterfeld, F. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

**7816** **Ground-state and transition charge densities in $^{192}$Os.** Reuter, W.; Shera, E.B.; Hoehn, M.V.; Hersman, F.W.; Milliman, T.; Finn, J.M.; Hyde-Wright, C.; Lourie, R.; Pugh, B.; Bertozzi, W. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review* [*Section*] *C: Nuclear Physics;* **30**: No. 5, 1465-1479(Nov 1984).

Elastic and inelastic electron-scattering cross sections of an Os-Pt transition region nucleus, $^{192}$Os, have been measured in a momentum transfer range from 0.6 to 2.9 fm$^{-1}$. The data for the ground and the J/sup $\pi$/ = 2$^+$, 2$^+$', 4$^+$, and 3$^-$ states were analyzed model independently with a Fourier-Bessel parametrization of the ground state and transition charge densities. The normalization of the (e,e') cross sections was obtained from a combined analysis with muonic-atom data for the ground and first 2$^+$ states. The densities and their radial moments are compared with theoretical predictions of the Davydov model and with axially symmetric deformed density-matrix-expansion Hartree-Fock calculations (including the Legendre expansion and the small-amplitude vibration model extensions).

**7817** **Measurement of the quadrupole moment of the 5$^-$ level in $^{206}$Hg.** Maier, K.H.; Menningen, M.; Ussery, L.E.; Nail, T.W.; Sheline, R.K.; Becker, J.A.; Decman, D.J.; Lanier, R.G.; Mann, L.G.; Stoeffl, W.; Struble, G.L. (Hahn-Meitner Institut fuer Kernforschung, Berlin, Federal Republic of Germany). *Physical Review* [*Section*] *C: Nuclear Physics;* **30**: No. 5, 1702-1705(Nov 1984).

The quadrupole coupling constant of the $\pi$(h/sub 11/2/$^{-1}$ s/sub 1/2/$^{-1}$)$_s$- isomer in polycrystalline $^{206}$Hg at 225 K has been measured by means of the perturbed angular distribution method. The result is e$^2$Qq/h = 136.5 +- 3 MHz, from which we deduce eQ = 65 +- 13 e fm$^2$ and an effective charge e/sub eff/($\pi$h/sub 11/2/$^{-1}$) = (2.2 +- 0.5)e. .AE

**7818** **Mass distributions in the reaction of 240 MeV $^{12}$C with $^{197}$Au.** Kudo, H.; Moody, K.J.; Seaborg, G.T. (Nuclear Science Division, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Physical Review* [*Section*] *C: Nuclear Physics;* **30**: No. 5, 1561-1572(Nov 1984).

The mass distributions of fission products and targetlike products in the reaction of 20 MeV/nucleon $^{12}$C with $^{197}$Au were determined radiochemically. The charge dispersions of the fission products were found to have Gaussian shapes with a width parameter ($2\sigma^2$) of 1.6 units and a most probable charge of 0.417A+1.4. As for near- and above-target products, the broad charge dispersions of A = 196 to 199 suggest contributions from two mechanisms, one corresponding to a quasielastic process and the other corresponding to deeply inelastic and/or complete fusion processes. The cross sections of above-target products were larger than the values expected from simple evaporation calculations.

**7819** **Quasielastic processes in the $^{28}$Si+ $^{208}$Pb reaction at 8 MeV per nucleon.** Kolata, J.J.; Rehm, K.E.; Kovar, D.G.; Stephans, G.S.F.; Rosner, G.; Ikezoe, H.; Vojtech, R. (Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review* [*Section*] *C: Nuclear Physics;* **30**: No. 1, 125-133(Jul 1984). Contract W-31-109-ENG-38.

Quasielastic yields have been measured for the $^{28}$Si+ $^{208}$Pb reaction at E/sub lab/($^{28}$Si) = 225 MeV. The inelastic scattering is dominated by excitation of the first 2$^+$ level in $^{28}$Si. The angular distribution for this state is found to contain insufficient information to determine accurately the quadrupole deformation parameter once the possibility of hexadecapole deformation is admitted. The ambiguity is resolved by requiring a simultaneous fit to the angular distribution of the first 4$^+$ state in $^{28}$Si. A large fraction of the total reaction cross section is found to be contained in quasielastic neutron transfer, and transfer of a single proton. It is shown that these large quasielastic yields are consistent with the expectations from distorted-wave Born approximation calculations.

**7820** **Inclusive measurement of quasifree (p,xn) charge exchange reactions on bismuth from 62 to 800 MeV.** D'Auria, J.M.; Dombsky, M.; Sheffer, G.; Ward, T.E.; Karwowski, H.J.; Yavin, A.I.; Clark, J.L. (Department of Chemistry, Simon Fraser University, Burnaby, British Columbia, Canada V5A 1S6). *Physical Review* [*Section*] *C: Nuclear Physics;* **30**: No. 1, 236-241(Jul 1984).

The total inclusive (p,xn) charge exchange reaction cross section on bismuth from 62 to 800 MeV was measured using activation and radiochemical techniques. These data for products with as many as 14 neutrons removed from the coherent product display the simple E$^{-1}$ dependence of the total cross section with incident projectile energy. The distribution of charge exchange products is discussed in terms of quasifree processes in (p,n) reactions. A model comparison between the data and an intranuclear cascade calculation was satisfactory as evidenced by reproducing the energy dependence, cross section magnitude, and mass yields for products up to 14 neutrons removed. Better agreement between the model and data were obtained with mean-free paths of nucleons in nuclear

matter twice as long as the one derived from nucleon-nucleon scattering.

## 6520 Nuclear Properties And Reactions, A=220 And Above

*REFER ALSO TO CITATION(S) 6520107812, 7830*

**7821 (BONN-HE—84-10) Measurement of the total cross section for $^{235}$U and $^{238}$U photofission in the Δ-resonance region.** Ahrens, J.; Arends, J.; Floss, N.; Huthmacher, S.; Mecking, B.; Stenz, R.; Kneissl, U.; Mank, G.; Ries, H.; Bourgeois, P. (Bonn Univ. (Germany, F.R.). Physikalisches Inst.). May 1984. 9p. NTIS (US Sales Only), PC A02/MF A01. File Number DE84752293.

The total cross section for the photoemission of fission fragments sigma (γ,F) has been measured for $^{235}$U and $^{238}$U using tagged bremsstrahlung photons in the energy range (120-460) MeV. The fission fragments were detected in parallel plate avalanche detectors. The results are compared with other formation on the total photonuclear absorption cross section.

**7822 (Juel-Spez—255, pp 19-20) Study of momentum transfer, mass distributions and total kinetic energies in the reaction $^{238}$U(α,α'f$_1$f$_2$).** Decowski, P.; Morsch, H.P.; Zemlo, L.; Rogge, M.; Turek, P.; Hlawatsch, G. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

**7823 (NEANDC(E)—228-L) Results of coupled channels calculations for the neutrons cross sections of a set of actinide nuclei.** Lagrange, C. (Nuclear Energy Agency, 75 - Paris (France)). Oct 1982. 125p. (INDC(FR)—56-L). NTIS (US Sales Only), PC A06/MF A01. File Number DE85700149.

This report gathers recent results of neutron interactions with the following actinide nuclei: $^{230}$Th, $^{232}$Th, $^{234}$U, $^{238}$U, $^{242}$Pu, $^{246}$Cm and $^{252}$Cf from the use of the coupled channels optical model. Tabulations of the following quantities are given in Annexe: total, direct elastic and inelastic scattering (integrated and differential), and compound nucleus formation cross sections; ground state generalized transmission coefficients needed to calculate the cross sections of partial compound nucleus processes. This work was carried out within the framework of the IAEA-NDS Coordinated Research Programme on the Intercomparison of Actinide Neutron Cross Section Evaluations.

**7824 E2 and E4 deformations in /sup 233,234,235,238/ U.** Zumbro, J.D.; Shera, E.B.; Tanaka, Y.; Bemis C.E. Jr.; Naumann, R.A.; Hoehn, M.V.; Reuter, W.; Steffen, R.M. (Princeton University, Princeton, New Jersey 08544). *Physical Review Letters;* **53**: No. 20, 1888-1892(12 Nov 1984).

Precise intrinsic quadrupole and hexadecapole moments of / sup 233,234,235,238/U have been determined from muonic K, L, M, and N x rays. For /sup 233,235/U seven E2 matrix elements were independently determined. These E2 matrix elements are in good agreement with the adiabatic rotational model; this agreement is further improved if a correction for ΔK = 1 band mixing is included. The measured hexadecapole moments are in good agreement with shell-correction calculations and Hartree-Fock calculations.

**7825 Angular momentum decomposition of single particle states in a potential with octupole deformation.** Chasman, R.R. (Chemistry Division, Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review* [*Section*] *C: Nuclear Physics;* **30**: No. 5, 1753-1756(Nov 1984). Contract W-31-109-ENG-38.

Tables of the spherical amplitudes $C^3(J,\pi)$ are given as a function of octupole deformation, for valence proton and neutron single particle states in the A = 225 mass region.

**7826 γ-ray emission probabilities for the $^{233}$U decay chain.** Gehrke, R.J.; Novick, V.J.; Baker, J.D. (Idaho National Engineering Lab., Idaho Falls). *International Journal of Applied Radiation and Isotopes;* **35**: No. 7, 581-589(Jul 1984).

Emission probabilities for several γ rays from members of the $^{233}$U decay chain have been determined. The emission probabilities of the 57 and 129 keV γ rays from the $^{233}$U decay were determined by 4πα-γ coincidence counting and γ-ray spectrometry. For chain equilibrium the emission probabilities, as number of γ rays per 100 decays of $^{229}$Th, for the 583- and 2614-keV $^{209}$Tl γ rays were calculated from a measured α branch intensity and decay scheme parameters. The γ-ray emission probabilities, as number of γ rays per 100 decays of $^{229}$Th. for the other chain member activities were also measured.

**7827 Spontaneous-fission properties and production of heavy-element isotopes.** Hoffman, D.C. (Los Alamos National Lab., NM). *Accounts of Chemical Research;* **17**: No. 7, 235-242(Jul 1984).

Spontaneous fission was discovered in $^{238}$U as a natural mode of decay as long ago as 1940. However, because of the long spontaneous-fission half-life of $^{238}$U of about $10^{16}$ years, the decay rate (specific activity) was so low that detailed studies of the properties of spontaneous fission had to await the synthesis of isotopes of higher Z elements with shorter spontaneous-fission half-lives. During the 1960s, milligram quantities of $^{252}$Cf became available to researchers through the Transplutonium Production Program of the US Atomic Energy Commission. The availability of $^{252}$Cf with a spontaneous-fission half-life of 85 years, and its resultant high specific activity, stimulated many pioneering studies of the spontaneous-fission process. detailed measurements of the mass, charge, and kinetic-energy distributions of the fission fragments, of prompt neutron and photon emission from the fragments, and the interrelationship of these properties were reported by numerous investigators. Since that time, studies of the spontaneous-fission properties of many other isotopes, some with half-lives of less than a second, have been made. 36 references, 12 figures, 2 tables.

**7828 Analysis of intermediate structure in the fission and capture cross sections of ($^{235}$U+n).** Moore, M.S.; Calabretta, L.; Corvi, F.; Weigmann, H. (University of California, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review* [*Section*] *C: Nuclear Physics;* **30**: No. 1, 214-217(Jul 1984).

Analysis of recent high resolution measurements of fission and capture cross sections of ($^{235}$U+n) between 2 and 32 keV has been done to extract the energy dependence of the average s-wave fission width and neutron strength function. A correlation analysis of the data indicates that the large fluctuations in α, the capture-to-fission ratio, are due to intermediate structure in the average fission width. The structure can be simulated by using a double-humped barrier model that takes into account coupling of class I and class II states in exactly the same way that has been used successfully to describe structure in subthreshold fission. These results suggest that the presence of intermediate structure is a general phenomenon in suprathreshold fission as well, and that, to describe such structure in the unresolved resonance region, one must include the coupling between class I and class II states.

## 6530 Nuclear Theory

**7829 (BNL—35325) Axial asymmetry in the IBA and an extensive new 0(6) region near A=130.** Casten, R.F. (Brookhaven National Lab., Upton, NY (USA); Koeln Univ. (Germany, F.R.). Inst. fuer Kernphysik). 1984. Contract AC02-76CH00016. 15p. (CONF-840906—16). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003215.

From Capture gamma-ray spectroscopy conference; Knoxville, TN, USA (10 Sep 1984).

Although the IBA-1 contains no solutions corresponding to a rigid triaxial shape, it does contain an effective asymmetry arising from zero point motion in a γ-soft potential leading to a non-zero mean or rms γ. In the consistent Q Formalism (CQF) of the IBA, most results of calculation depend only on one parameter chi. A re-

lation will be established between chi and the effective asymmetry parameter $\gamma$. The relation between the asymmetry occurring naturally in IBA-1 and the triaxiality arising from the introduction of cubic terms into the IBA Hamiltonian will be discussed. It will be shown that $\gamma$-band energy staggering is a particularly sensitive indicator of the degree of $\gamma$ rigidity. Finally, an extensive new region of 0(6) like Xe and Ba nuclei near A=130 will be discussed. Their remarkable similarity to Pt will be explored. Deviations from the strict 0(6) limit can be described in terms of the interplay of soft and rigid axial asymmetry and calculations will be presented that interpret the Xe, Ba and Pt isotopes in this way. 25 references.

7830 **(GSI—84-32-Prepr.) Particle exchange as the dissipative mechanism in nucleus-nucleus collisions.** Feldmeier, H.; Spangenberger, H. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). May 1984. 17p. (CONF-8405179—4). NTIS (US Sales Only), PC A07/MF A01. File Number DE84752292.

From International conference on theoretical approaches to heavy ion reaction mechanisms; Paris, France (14 May 1984).

We discuss a model where the colliding nuclei are treated as two Fermi gases which exchange particles, momentum and entropy through a window in the mean single particle potential. Even at zero temperature transfer of particles is possible because phase space which is not Pauli blocked is available due to unequal Fermi distributions on either side of the window. The difference comes about by a possible mismatch of the mean velocities, of the chemical potentials and of the temperatures. Based on this picture we discuss in a unified manner a variety of dissipative phenomena like mass drift, thermal feed back on the mass drift, partition of excitation energy, energy and angular momentum dissipation, and fluctuations in the relative momentum and mass number.

7831 **(GSI—84-34-Prepr.) Empirical description of the element production cross sections in dissipative heavy-ion collisions.** Wollersheim, H.J. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Jun 1984. 26p. NTIS (US Sales Only), PC A03/MF A01. File Number DE84752337.

Correlations between experimental observables yield analytical expressions for the energy dsigma/dE and element distributions dsigma/dZ, $d^2$sigma/dZdE in dissipative collisions. These empirical formulas are applied to twelve heavy ion systems at bombarding energies well above the Coulomb barrier. The element production can be calculated for all kinetic energies of the reaction fragments from the quasi-elastic region down to a minimum total kinetic energy Vsub(c)sup(def) which is the result of the Coulomb repulsion of two deformed nuclei prior to scission. In cases where the dissipative collisions are the dominant part of the reaction process, the deformed Coulomb energy can also be deduced from the total reaction cross section. For these heavy ion systems the empirical formulas depend only on quantities of the ingoing channels. Especially, the normalization of the Gaussian shaped element distributions indicates that the reminiscence on the entrance channel is not completely lost in dissipative collisions. For the $^{209}$Bi + $^{136}$Xe reaction at a laboratory bombarding energy of 1130 MeV the energy and element distributions are calculated which show an excellent agreement with the experimental data.

7832 **(INFN/BE—83-8) (p, $\alpha$) reactions: knock-on(out) or pick-up.** Gadioli, E. (Istituto Nazionale di Fisica Nucleare, Milan (Italy)). 1983. 28p. (In Italian). (CONF-8310334—1). NTIS (US Sales Only), PC A03/MF A01. File Number DE85700147.

From 69. national congress of Italian Physical Society; Messina, Italy (21 Oct 1983).

Nothwithstanding the great amount of data collected starting from the beginning of the fifties, it cannot be said that a good degree of knowledge about the (p, $\alpha$) reaction mechanism has been reached. Experimental data are usually interpreted or on the basis of a pure pick-up or knock-on(out) mechanism, though many results suggest the importance of both mechanism.

7833 **(INIS-mf—9074) Cluster transfer form factor and intercluster relative motion in the orthogonality-condition model.** Lovas, R.G.; Pal, K.F. (Magyar Tudomanyos Akademia, Debrecen. Atommag Kutato Intezete). Jan 1984. 26p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85780127.

The orthogonality-condition model (OCM), as an approximation method for calculating the overlap and potential overlap functions involved in the form factor of transfer reactions, is tested against microscopic cluster calculations for the $^7$Li=$\alpha$+t system. The OCM overlap and potential overlap turned out to depend strongly on the OCM potential although the potentials are chosen so as to produce the same asymptotic phase. Excellent approximations to microscopic overlaps and potential overlaps are, however, obtained by optimizing the OCM potential so that the OCM may reproduce the microscopic energy surface. This way the dependence on the OCM potential is traced back to the underlying nucleon-nucleon force.

7834 (INIS-mf—9078, pp 337-361) **Simple shell-model relationships between negative-parity energy level structures of even-mass nuclei pairs A=30-40.** Van der Merwe, J.H.; Saayman, R. (Stellenbosch Univ. (South Africa). Dept. of Physics); Van der Merwe, A.J. (Denver Univ., CO (USA). Dept. of Physics and Astronomy). 1984. (In Afrikaans). NTIS (US Sales Only), PC A18/MF A01. File Number TI85780085. (CONF-8307139—; CONF-8207113—).

From 18. annual seminar on theoretical physics; Pretoria, South Africa (11 Jul 1983).

Simple relationships between the negative-parity energy level structures of the even-mass nuclei pairs A = 30 and 32, 34 and 36, 34 and 38, 40 and 38 are established-along lines similar to the well-known Pandya transformation between the particle-hole spectrum of $^{40}$K and the particle-particle spectrum of $^{38}$Cl. The relationships are generated within the framework of the jj-coupling shell model, using standard Racah algebra, and no assumption is made about the physical nature of the nuclear two-body interaction. Candidates for the $1f_{7/2}$ and $2p_{3/2}$ multiplets are selected on the basis of their measured spectroscopic strengths in l = 3 or 1 single particle transfer reactions with due allowance for member fragmentation and mixing between the two configurations in terms of the calculation of spectroscopic-strength weighted centroids. The calculated correlated energy spectra are discussed with reference to the results of previous interaction-dependant shell-model calculations, especially those employing the modified surface delta interaction. Consideration is also given to uncertain or ambiguous spin and parity assignments, deduced two-body interaction matrix elements, and the isospin T = 0 and 1 and single-particle $1f_{7/2}$ and $2p_{3/2}$ splittings.

7835 (INIS-SU—228, pp 44-52) **Comparison between various methods of giant resonance excitation.** Ehramzhyan, R.A. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1982. (In Russian). NTIS (US Sales Only), PC A13/MF A01. File Number TI84780397. (CONF-8106173—).

From 5. seminar on electromagnetic interactions of nuclei at low and medium energies; Moscow, USSR (15 Jun 1981).

Processes resulting in concentration of transition forces in a certain energy range of nuclear spectrum are discussed for investigating the nature of excitation in nuclei of giant resonances of different multipolarity. Structure of the interaction operator of an incident particle with a nucleon of the nucleus determining the type of excited resonances is considered. The role of contributions of quasi-free scattering of an incident particle on nucleons of the nucleus or associations and contributions of transitions associated with multistage excitation of the nucleus is pointed out on the example of the reaction of $\pi$-meson radiative capture by the nucleus. The role of these effects grows with the increase of momentum transfer. Charge-exchange (p, n) and (n, p) reactions in the energy range of an incident particle up to 200 MeV which extract spin-isospin branch of excitation of the nucleus-target are discussed. Partial spectra of nucleus excitation extracting the most distinct resonance structure are considered. It is necessary to extract contributions of different mechanisms for quantitative description of resonance characteristics. For the present it is not managed to suggest a simple rule permitting to exclude the effect of a continuous spectrum of

the nucleus. It is concluded that it is necessary to use different kinds of particles for the solution of problems associated with contribution of different mechanisms of nucleus excitation.

7836 (INIS-SU—228, pp 172-181) **Excitation of the ΔS=1 charge-exchange giant resonances in proton reactions.** Urin, M.G. (Moskovskij Inzhenerno-Fizicheskij Inst. (USSR)). 1982. (In Russian). NTIS (US Sales Only), PC A13/MF A01. File Number TI84780397. (CONF-8106173—).

From 5. seminar on electromagnetic interactions of nuclei at low and medium energies; Moscow, USSR (15 Jun 1981).

The purpose of the paper is to test applicability of the shell model to the theory of giant resonances and to obtain data on properties of spin-isospin part of nucleon effective interaction in nuclei. Experiments on investigation of isobaric analog resonances (IAR) and giant Gamov-Teller resonances (GTR) in intermediate nuclei from Zr to Pb are described. The conducted qualitative analysis of certain parameters of charge- exchange ΔS--1-GTR reveals that comparison of the experimental parameters and those calculated within the frames of optical-shell model of nuclear reactions for excitation cross sections of the mentioned GTR in reactions with protons permits to obtain interesting data both on the structure and mechanism of excitation of these giant resonances.

7837 (INIS-SU—228, pp 182-195) **Gamow-Teller resonance (experimental and theoretical status).** Gaponov, Yu.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii); Lyutostanskij, Yu.S. (Moskovskij Inzhenerno-Fizicheskij Inst. (USSR)). 1982. (In Russian). NTIS (US Sales Only), PC A13/MF A01. File Number TI84780397. (CONF-8106173—).

From 5. seminar on electromagnetic interactions of nuclei at low and medium energies; Moscow, USSR (15 Jun 1981).

Experimental and theoretical investigations of observed charge-exchange reactions of p anti n- and n anti p-types on intermediate and heavy nuclei of isobaric 1+H+ states of spherical nuclei and giant Gamov-Teller resonance (GTR) are discussed in detail. Modern state of experimental studies of GTR in all the nuclei up to $^{208}$Pb is described. Microscopic description of isobaric states of spherical nuclei in the theory of finite fermi systems is given.

7838 (INIS-SU—228, pp 110-120) **Direct mechanism in knockout reactions with real and virtual photons and single particle response of nuclei.** Boffi, S. (Bologna Univ. (Italy). Ist. di Fisica; Pavia Univ. (Italy). Ist. di Fisica Nucleare; Pavia Univ. (Italy). Ist. di Fisica Teorica). 1982. NTIS (US Sales Only), PC A13/MF A01. File Number TI84780397. (CONF-8106173—).

From 5. seminar on electromagnetic interactions of nuclei at low and medium energies; Moscow, USSR (15 Jun 1981).

A detailed analysis of nucleon knockout reactions both with real and virtual photons is presented on order to clarify unsatisfactory results concerning the single particle response on finite nuclei. Some recent work is presented aiming at gaining information on the spectral density from (e, e', p) and (γ, p) reactions. The mathematical properties of the spectral density are briefly reviewed. The central role of the spectral density in the direct mechanism is discussed in terms of a recently derived equation for the related spectroscopic amplitudes. Some results of a phenomenological calculation are reported.

7839 (INS—462) **High multiplicity events in ultra-relativistic heavy ion collisions.** Sumiyoshi, H. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Feb 1983. 15p. NTIS (US Sales Only), PC A02/MF A01. File Number DE84703234.

From the viewpoint that a nucleus-nucleus interaction is composed of the multiple nucleon-nucleon collisions, we analyze the mean multiplicities of the ultra-relativistic heavy ion collisions. Most of the experimental data are well settled within our framework. The relationship between this and other models are briefly discussed.

7840 (INS—467) **Geometry of the self-consistent collective-coordinate method for the large-amplitude collective motion. Stability condition of 'maximally-decoupled' collective submanifold.** Sakata, Fumihiko; Marumori, Toshio; Hashimoto, Yukio; Une, Tsutomu. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). May 1983. 33p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85700136.

The geometry of the self-consistent collective-coordinate (SCC) method formulated within the framework of the time-dependent Hartree-Fock (TDHF) theory is investigated by associating the variational parameters with a symplectic manifold (a TDHF manifold). With the use of a canonical-variables parametrization, it is shown that the TDHF equation is equivalent to the canonical equations of motion in classical mechanics in the TDHF manifold. This enables us to investigate geometrical structure of the SCC method in the language of the classical mechanics. The SCC method turns out to give a prescription how to dynamically extract a "maximally-decoupled" collective submanifold (hypersurface) out of the TDHF manifold, in such a way that a certain kind of trajectories corresponding to the large-amplitude collective motion under consideration can be reproduced on the hypersurface as precisely as possible. The stability of the hypersurface at each point on it is investigated, in order to see whether the hypersurface obtained by the SCC method is really an approximate integral surface in the TDHF manifold or not.

7841 (INS—475) **Energy and momentum dissipations of a few GeV hadron in the nucleus.** Sato, H.; Ichimura, A.; Sumiyoshi, H. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Jul 1983. 13p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700142.

Hadron-nucleus reactions in the few GeV region are investigated with a modified Glauber model. The incident hadron loses its energy and momentum by multiple hadronic excitations of target nucleons, and the moving source is assumed to be formed by decay products of these hadronic excitations. The energy and target mass dependences of the multiplicity and the momentum loss of the incident hadron are well reproduced. It is found that the velocity and temperature of the moving source increase and saturate with increasing incident energy.

7842 (JINR—R-6-83-518) **Study on the neutrino properties in radioactive decay: situation and prospects. Double beta decay. Polarization phenomena.** Vylov, Ts. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1983. 26p. (In Russian). (CONF-8304144—1). NTIS (US Sales Only), PC A03/MF A01. File Number DE84703232.

From 23. conference on nuclear spectroscopy and nuclear structure; Moscow, USSR (19 Apr 1983).

The present state and prospects of the investigations of double $\beta$-decay and some polarization phenomena in radioactive decay are described. Conclusions of the theory are summarized, which are important for the experiment aimed at searching for $2\beta$-decay, as well as for analysis of the obtained data. The experimental results are systematized and the most interesting experiments on $2\beta$-decay are reviewed. The trends in development of technique for new projects aimed at searching for double neutrinoless $\beta$-decay are analysed. The effects, which limit sensitivity of experiments and should be thoroughly investigated by the methods of nuclear spectroscopy, are considered. An outlook on the improvement of accuracy of some polarization experiments with neutrino is discussed, including measurements of neutrino helicity by means of Ge(Li) and HPGe detectors.

7843 (Juel-Spez—255, pp 28) **How does the optical potential depend on nuclear excitations.** Machner, H. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

7844 (Juel-Spez—255, pp 80-81) **Relativistic Hartree-Fock description of magic nuclei.** Klemt, V. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

7845 (Juel-Spez—255, pp 81) **Microscopic look at the nuclear twist.** Schwesinger, B. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

7846 (Juel-Spez—255, pp 82) **Effective quasi-particle G-matrix interaction.** Nakayama, K.; Love, W.G.; Krewald, S.; Speth, J. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

7847 (Juel-Spez—255, pp 83) **Fission barrier calculation for rotating nuclei.** Nemeth, J.; Irvine, J.M.; Okolowicz, J. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

7848 (Juel-Spez—255, pp 84-85) **Effective mass in nuclei and the level density parameter.** Prakash, M.; Ma, Z.Y.; Wambach, J. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

7849 (Juel-Spez—255, pp 88) **Medium polarization effects: A crucial ingredient in the Δ(1232)-nucleon interaction.** Nakayama, K.; Brown, G.E.; Krewald, S.; Speth, J. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

7850 (Juel-Spez—255, pp 93) **Equilibrium between anisotropic normal and pion condensed nuclear matter.** Lovas, I.; Nemeth, J.; Sailer, K. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

7851 (Juel-Spez—255, pp 103-104) **ATDHF calculations with Skyrme interaction.** Gissler, R.; Goeke, K.; Gruemmer, F. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

7852 **(PER—83) Calculation of multi-group fission spectrum vectors.** Mueller, E.Z. (Nuclear Development Corp. of South Africa (Pty.) Ltd., Pelindaba, Pretoria). May 1984. 45p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85700145.

In this report, the problem of calculating fission spectrum vectors in a consistent manner is formulated. The practical implications of using fission spectrum vectors in multi-group transport calculations are also addressed. The significance of the weighting spectra used for the calculation of fission spectrum vectors is illustrated for the case of a simple neutronic assembly.

7853 **Vector polarization in reactions with spin-1 particles.** Goldstein, G.R.; Moravcsik, M.J. (Department of Physics, Tufts University, Medford, Massachusetts 02155). *Physical Review Letters;* **53**: No. 20, 1885-1887(12 Nov 1984).

It is shown that in any reaction involving partially or entirely, spin-1 particles, the reaction amplitudes can be completely determined from a set of experiments that does not include measurements of vector polarization for any of the spin-1 particles in the reaction. In this sense, measurements of the vector polarization of any of the spin-1 particles in the reaction are dispensable. The result is applicable to any nuclear or particle reaction, for example, those containing deuterons, rho mesons, etc.

7854 **Are antibaryons a signal for a phase transition in ultrarelativistic nucleus-nucleus collisions?.** DeGrand, T.A. (Department of Physics, University of Colorado, Boulder, Colorado 80309). *Physical Review* [*Section*] *D: Particles and Fields;* **30**: No. 9, 2001-2004(1 Nov 1984).

In this paper it is speculated that antibaryon production in relativistic nucleus-nucleus collisions is a signal for phase transition from a high-temperature Debye-screened and chirally symmetric phase to a low-temperature confined and chirally broken phase. In a chiral model for the transition where baryons are topological excitations the production of baryons and antibaryons takes place by the Kibble mechanism. A qualitative discussion of possible experimental signatures is given.

7855 **Precompound nucleon angular distributions in the continuum.** Blann, M.; Scobel, W.; Plechaty, E. (Lawrence Livermore National Laboratory, University of California, Livermore, California 94550). *Physical Review* [*Section*] *C: Nuclear Physics;* **30**: No. 5, 1493-1508(Nov 1984).

Angular distributions for nucleon-induced reactions (incident energies 14 to 90 MeV) leading to precompound nucleon emission in the continuum (emitted particle energies 9—70 MeV) are calculated based on nucleon-nucleon scattering kinematics for an incident nucleon on a Fermi gas. Analytic expressions due to Kikuchi and Kawai are used for the single scattering kernel. The geometry dependent hybrid model is used to generate the differential cross sections for first, second, etc., order scattering, these weightings being used to fold the single scattering kernel. Results are found to reproduce all experimental angular distributions quite well at angles in the 20°—90° range. Ad-hoc modifications to approximate quantal effects and Coulomb deflections are explored, but the results do not seem to offer a consistent means of reproducing back angle yields, and give generally poorer results at very forward angles.

7856 **Unusual optical potential in prior-form breakup theory.** Austern, N. (Department of Physics and Astronomy, University of Pittsburgh, Pittsburgh, Pennsylvania 15260). *Physical Review* [*Section*] *C: Nuclear Physics;* **30**: No. 4, 1130-1131(Oct 1984).

The optical potential for the center of mass of two fragments in a three-body breakup channel does not resemble elastic optical potentials obtained in two-body channels. As a consequence the value of prior-form distorted wave Born approximation breakup theories based on center-of-mass optical potentials is questionable.

7857 **Noncompact-kernel integral equation for three-body scattering: nd quartet equation and numerical results.** Payne, G.L.; Klink, W.H.; Polyzou, W.N.; Friar, J.L.; Gibson, B.F. (Department of Physics and Astronomy, The University of Iowa, Iowa City, Iowa 52242). *Physical Review* [*Section*] *C: Nuclear Physics;* **30**: No. 4, 1132-1139(Oct 1984).

We propose a new integral equation description of three-body scattering which has a noncompact kernel. It is shown that one can impose supplemental boundary conditions which select the unique, physical solution. To demonstrate that the equation has a form convenient for numerical calculation, we utilize the equation to calculate numerical results for nd quartet elastic scattering at energies below the threshold for three-body breakup. The solutions are accurate and stable, even at energies near the three-body breakup threshold. Comparison is made with previously published numerical calculations employing s-wave local potentials.

7858 **Noncompact-kernel integral equation for three-body scattering: Derivation of boundary conditions.** Polyzou, W.N.; Klink, W.H.; Payne, G.L. (Department of Physics and Astronomy, The University of Iowa, Iowa City, Iowa 52242). *Physical Review* [*Section*] *C: Nuclear Physics;* **30**: No. 4, 1140-1145(Oct 1984).

We derive the necessary boundary conditions required to ensure unique solutions of a new noncompact-kernel integral equation for three-particle scattering. We give an abstract analysis to determine all solutions of this equation. Configuration space boundary conditions are derived to single out the physical solution.

7859 **Observation of weak γ-ray transitions in $^{52}$Cr using an efficient isotope identification technique for fusion-evaporation reactions.** Kozub, R.L.; Chitwood, C.B.; Fields, D.J.; Lister, C.J.; Warburton, E.K. (Department of Physics, Tennessee Technological University, Cookeville, Tennessee 38505). *Physical Review [Section] C: Nuclear Physics;* **30**: No. 4, 1324-1327(Oct 1984). Contract AC02-76ER03069.

Gamma-ray transitions in /sup 52,53/Cr and /sup 54,55/Mn have been observed using $^{7}$Li($^{51}$V,xn yp zα γ) fusion-evaporation reactions and γ-particle coincidence techniques. The experiment involved the same reaction at the same center-of-mass energy as the earlier work of Poletti et al., but with target and projectile interchanged. In the present work, eight additional transitions have been identified as occurring in $^{52}$Cr. This provides corroboration of results obtained more recently via $^{50}$Ti(α,2nγ)$^{52}$Cr reaction studies. A simple, efficient approach to the spectroscopy of weakly populated nuclear states which provides for unambiguous isotopic assignments is thus demonstrated.

7860 **Angular-dependent partial widths in resonance reactions.** Doehnert, L.; Feshbach, H. (Center for Theoretical Physics, Laboratory for Nuclear Science, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Physical Review [Section] C: Nuclear Physics;* **30**: No. 4, 1358-1359(Oct 1984). Contract AC02-76ER03069.

In this paper we show that if a resonant state corresponding to a deformed nuclear system is specified by a well defined orientation of its principal axes then the partial width, which appears in the resonant scattering amplitude, depends on the angle between the direction of the emitted particle and the preferred direction of the resonant state. This effect may be observed in the scattering of actinide nuclei.

7861 **Hydrodynamic evolution of quark-gluon plasma produced by ultrarelativistic nuclear collisions.** Glendenning, N.K.; Matsui, T. (Lawrence Berkeley Lab., CA). *Physics Letters, [Section] B;* **141**: No. 5/6, 419-424(5 Jul 1984).

The hydrodynamic evolution of a quark-gluon plasma, produced in the central rapidity region, is studied incorporating the external bag pressure acting on the plasma surface. It is shown that the plasma fluid, which undergoes the scaling longitudinal expansion, generates a non-trivial transverse flow pattern, near the plasma surface, consisting of a rarefaction wave and a compression wave, instead of a simple rarefaction wave in the case of free expansion without a surface boundary condition. We also discuss a possible global phase transition of supercooled plasma, in the interior of the cylinder, to a superheated dense hadron gas through a time-like surface of discontinuity.

7862 **Behavior of pions incident on a slab of uniform complex nuclear material.** Mehrem, R.A.; Radi, H.M.A.; Rasmussen, J.O. (Physics Department, Faculty of Science, Kuwait University, Kuwait and Nuclear Science Division, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Physical Review [Section] C: Nuclear Physics;* **30**: No. 1, 301-304(Jul 1984). Contract AC03-76SF00098.

A model is presented for the scattering of obliquely incident relativistic pions from a region of uniform nuclear matter. A simple analytic method that incorporates a second order optical potential in the Klein-Gordon equation is constructed. This method gives only one physically acceptable solution for which the real and imaginary parts of the wave number, k, inside nuclear matter are positive for all possible values of incident pion wave numbers, $k_0$. Reflectivity of pions indicates that the nuclear surface has higher transmission around T/sub π/≅35 MeV than at other energies, since the index of refraction of nuclear matter is near to unity there. The pion mean free path as a function of pion energy is plotted and discussed.

7863 **Nonmesonic decay of heavy Λ hypernuclei.** McKellar, B.H.J.; Gibson, B.F. (Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545 and School of Physics, University of Melbourne, Parkville, Victoria 3052, Australia). *Physical Review [Section] C: Nuclear Physics;* **30**: No. 1, 322-330(Jul 1984).

We have calculated the ratio of the rate for nonmesonic decay of the Λ in nuclear matter to that of the free Λ decay rate using a pion and rho meson exchange model. Including tensor force effects and a final-state correlation function generated from the Reid-soft-core potential, we estimate Γ/sub nm//Γ/sub free/ to be of order 1. A discrepancy with respect to the prior estimate of Adams is resolved.

7864 **Small effects in sub-barrier heavy-ion elastic scattering.** Hussein, M.S.; Franzin, V.L.M.; Franzin, R.; Baltz, A.J. (Instituto de Fisica, Universidade de So Paulo, So Paulo, SP, Brazil). *Physical Review [Section] C: Nuclear Physics;* **30**: No. 1, 184-194(Jul 1984). Contract AC02-76CH00016.

The effects of virtual Coulomb excitation of giant multipole resonances as well as of relativity on sub-barrier elastic scattering of heavy ions are investigated. Closed expressions for the effect of giant quadrupole and octopole excitation from the adiabatic polarization potential, on the elastic scattering differential cross section, are derived. Comparison with optical model and coupled channels calculations is reported. The effect of special relativity on the Rutherford cross section is also described in a closed form.

7865 **Comparison of approximate chiral-dynamical $\pi N \rightarrow \pi\pi N$ models used in A(π,2π) calculations.** Bhalerao, R.S.; Liu, L.C. (Isotope and Nuclear Chemistry Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review [Section] C: Nuclear Physics;* **30**: No. 1, 224-231(Jul 1984).

The relative importance of the diagrams contributing to the $\pi N \rightarrow \pi\pi N$ reaction in the framework of the Weinberg effective Lagrangian theory is investigated. Total production cross sections, pion-pion angular correlations, and the energy spectrum of the outgoing nucleon given by various approximate schemes proposed in the literature are found to be very different from those predicted by the Weinberg theory. We indicate the inadequacies of these approximate schemes and discuss their implications to the predicted (π,2π) total cross sections on complex nuclei. The relevance of our findings to microscopic models for pion-nucleus double charge exchange reactions is also discussed.

7866 **Interference effects in (π,πN) reactions.** Ohkubo, Y.; Liu, L.C. (Isotope and Nuclear Chemistry Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review [Section] C: Nuclear Physics;* **30**: No. 1, 254-264(Jul 1984).

Contributions of quasifree and nonquasifree reaction processes to (π,πN) reactions have been investigated across the (3,3) resonance region. We demonstrate that the quantum mechanical interference between these two types of reaction processes significantly affects the calculated $\pi^-$- and $\pi^+$-induced cross sections, as well as their ratio. In the case of incident $\pi^-$, the contributions from the interference term even exceed those from the pure nonquasifree term. This investigation of the (π,πN) reaction thus indicates that the interpretations given to the parameter introduced into various published semiclassical models, in which interference effects were ignored, are incorrect.

## 6540 Radiation And Shielding Physics

*REFER ALSO TO CITATION(S) 6540007159*

7867 **(FEI—1428) Theory of linear albedo operators in Banach spaces.** Abramov, B.D.; Shikhov, S.B. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1983. 26p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. File Number DE84703230.

A scope of problems composing the subject of the albedo operators (AO) theory is considered. The AO term is meant as an operator permitting to determine the neutron density (ND) distribution at the surface of some medium for neutrons escaping it on the basis of the preset ND, distribution for neutrons entering this medium. Spaces of summed functions are introduced, the fact of AO existence, linearity and limitedness by R and S is established. Considering the problem with two subareas continiuty and positiveness of the definite compositions of two AO is shown. Their spectral radii are estimated, the critical problem is conventionally formulated in terms of AO and their basic properties are found. These properties are generalized over the case of partitioning of the area into an arbitrary finite number of subareas. It is shown that the corresponding boundary integral equation (BIE) for ND at the subarea interfaces has an unambiguous solution that can be found by the method. The relation between such methods of BIE solution and the integration principle over subareas is noted. The methods of BIE solution for quasi-one-dimensional problems are considered in detail. It is shown that the BIE solution patterns non-equivalent to the pass method and iterative method may be incorrect. The features of a conventionally critical problem are formulated. The results can be used for developing and grounding the BIE method algorithms as a version of the methods for solving boundary problems of the neutron transport theory.

7868 **(INIS-mf—9162) Temperature dependence of thermal neutron scattering cross sections for hydrogen bound in moderators.** Keinert, J. (Stuttgart Univ. (Germany, F.R.). Inst. fuer Kernenergetik und Energiesysteme). (Fachinformationszentrum Energie, Physik, Mathematik G.m.b.H., Eggenstein-Leopoldshafen (Germany, F.R.)). 1982. 141p. NTIS (US Sales Only), PC A07/MF A01. File Number DE85780157.

To understand neutron thermalization in moderators containing hydrogen it is important to know the neutron-nuclei scattering dynamics explaining the temperature dependence of scattering cross sections in the thermal energy region. For the moderator materials light and heavy water, polyethylene and the metal hydrides of zirconium and yttrium differential and integral scattering cross sections are evaluated and compared to the free gas approximation at relevant temperatures. The data are presented in graphical and tabular form.

7869 (INIS-SU—252, pp 92-94) **Stopping power and charged particle ranges in reactor materials.** Borzakovskij, A.E.; Mayatskij, V.D.; Pucherov, N.N. (AN Ukrainskoj SSR, Kiev. Inst. Yadernykh Issledovanij). 1983. (In Russian). NTIS (US Sales Only), PC A06/MF A01. File Number TI85780019.

In Radiation damage physics and radiation technology.

7870 (INIS-SU—259, pp 413-420) **Space-energetic distributions of fast neutrons in the materials of blanket and thermonuclear reactor shields.** Broder, D.L.; Gromov, L.A.; Gureev, V.I.; Petrzhak, K.A.; Teplykh, V.F.; Leshchiner, M.E.; Khandurov, N.V.; Kovrigin, B.S.; Gotlib, D.I.; Matvejkov, N.I. (Moskovskij Ehnergeticheskij Inst. (USSR). 1982. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number TI85780020. (CONF-8106209—Vol.4).

From 2. all-union conference on engineering problems of thermonuclear reactors; Leningrad, USSR (23 Jun 1981).

Spectra measurement of slowing-down neutrons with the initial energy 15 MeV in lead and graphite of thermonuclear reactor containment under certain geometrical conditions convenient for comparison with calculations are made. Neutron generation NG-200 is used as a neutron source. Flowsheet of experimenal fuel assemblies is presented. Precise technique of reduction of measured neutron spectra is mentioned. Measurement results of spatial and energy distributions of energy group neutrons 14.5-15.0, 14.0-14.5, 10.5-14.0, 6.5-10.5, 4-6.5, 3-4 MeV in graphite and lead are presented in a graphic form. Lengths of neutron relaxations are calculated. It is shown that neutron flow in all graphite thicknesses has the minimum in the energy range 11-13 MeV, and in all lead thickness - minimum in the range 9-14 MeV. The data obtained do not contradict the known data and specify them.

7871 (KURRI-TR—225, pp 3-7) **Ultra cold neutron experiments.** Okumura, Kiyoshi; Utsuro, Masahiko (Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst.). 1982. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. File Number TI85780080. (CONF-8202104—).

From Study meeting on research technology; Kumatori, Osaka, Japan (10 Feb 1982).

The preliminary experiment of the detection of ultra cold neutrons has been performed. The ultra cold neutrons have the energy of $10^{-7}$ eV. which is smaller than the effective potential from nuclei. Accordingly, the ultra cold neutrons are reflected from the surface of a material. It is possible to confine the ultra cold neutrons in a box with reflective inner surfaces. Neutron bottle experiment was performed by using an electron linear accelerator at Kyoto University Research Reactor Institute. The counting more than background was observed. The measurement of neutron energy by the TOF method was carried out, and it can be said that the ultra cold neutrons were detected.

7872 **(RAL—84-020) Momentum distribution of light atoms by deep inelastic neutron scattering.** Taylor, A.D. (Rutherford Appleton Lab., Chilton (UK)). Mar 1984. 31p. (CONF-840264—7). NTIS (US Sales Only), PC A03/MF A01. File Number DE84703194.

From Workshop on high energy excitations in condensed matter; Los Alamos, NM, USA (13 Feb 1984).

The development of deep inelastic neutron scattering, where neutrons of one eV or more are used to achieve momentum transfers in the impulse limit, is outlined. Scattering data from light atoms at high momentum transfers are presented and the results discussed.

7873 **(SAND—84-0573) ITS: the Integrated TIGER Series of coupled electron/photon Monte Carlo transport codes.** Halbleib, J.A.; Mehlhorn, T.A. (Sandia National Labs., Albuquerque, NM (USA)). Nov 1984. Contract AC04-76DP00789. 105p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE85003719.

ITS is a powerful and user-friendly software package permitting state-of-the-art Monte Carlo solution of linear time-integrated coupled electron/photon radiation transport problems, with or without the presence of macroscopic electric and magnetic fields of arbitrary spatial dependence. Our goal has been to simultaneously maximize operational simplicity and physical accuracy. Through a machine portable utility that emulates the basic features of the CDC UPDATE processor, the user selects one of eight codes for running on a machine of one of four (at least) major vendors. The ease with which this utility is applied combines with an input scheme based on order-independent descriptive keywords that makes maximum use of defaults and internal error checking to provide experimentalists and theorists alike with a method for the routine but rigorous solution of sophisticated radiation transport problems. Physical rigor is maximized by employing the best available cross sections and sampling distributions, and the most complete physical model for describing the production and transport of the electron/photon cascade from 1.0 GeV down 1.0 keV. Flexibility of construction permits the more sophisticated user to tailor the codes to specific applications and to extend the capabilities of the codes to more complex applications through simple update procedures.

7874 **Interference coatings for neutrons.** Majkrzak, C.F. (Brookhaven National Laboratory, Physics Department, Upton, New York 11973). *Applied Optics;* **23**: No. 20, 3524-3528(15 Oct 1984). Contract AC02-76CH00016.

A review of multilayer thin films devices for monochromating and/or polarizing neutrons with wavelengths of the order of 1 A and longer is given.

## 6550 Medical Physics

*REFER ALSO TO CITATION(S) 6550007245, 7472, 7473, 7483, 7485, 7493*

7875 **(FS—83-32-T) Aspects of radiation protection with regard to radioactive contamination.** (Fachverband fuer Strahlenschutz e.V., Karlsruhe (Germany, F.R.)). Nov 1983. 669p. (In German). (CONF-8306168—). Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland).

From 17. annual meeting of Fachverband fuer Strahlenschutz e.V.; Aachen, F.R. Germany (8 Jun 1983).

The Fachverband fuer Strahlenschutz e.V., member of the 'International Radiation Protection Association (IRPA)' for the Federal Republic of Germany and Switzerland held its 17th annual meeting from June 8 through 10 at Aachen. The meeting was designed to allow a great deal of information sharing concerning recent findings and experience gained in the field of radiactive contamination and decontamination. The topics discussed included the occurrence, prevention, detection and removal of contaminations and the resulting radiation exposure at work in laboratories, medical and nuclear facilities, of persons exposed to radiation on account of their occupation, of components and systems in nuclear facilities and power plants, with respect to dose rate minimization, choice of materials, construction, decommissioning and ultimate removal as well as national and international regulations and standards.

7876 (FS—83-32-T, pp 23-30) **National and international regulations in the field of contamination and decontamination.** Spang, A. Nov 1983. (In German). Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland). (CONF-8306168—).

From 17. annual meeting of Fachverband fuer Strahlenschutz e.V.; Aachen, F.R. Germany (8 Jun 1983).

Comparison of national with international regulations in the field of contamination reveals a remarkable variety with limits differing by up to 2 orders of magnitude. There is a combination of various reasons for this situation: - There are significant differences between definitions of terms. - Apart from ICRP No. 25, no other ICRP publications, nor the IAEA state concrete recommendations. - The scientific base for technically substantiated limits can be established only with great difficulty. Even if levels vary, the limits for $\alpha$-emitters for toxicity class 1 and for $\beta$-, $\gamma$-emitters of toxicity classes 2 to 4 generally differ by only one order of magnitude. Under these circumstances, the limits for contamination appear to follow from practical experience rather than being based on scientific principles. Governmental regulations for decontamination are uncommon, nor are they considered necessary. At best, the pertinent recommendations by IAEA could be constructed as general directions since, for example, - different surface materials - different radionuclides - different decontamination objectives call for consideration of many factors. It is reasonable to leave it to the competent personnel to determine protection measures actually necessary for dealing with contamination and the procedures expedient for decontamination; to be stipulated by governmental regulations can and should at best establish the framework for such arrangements.

7877 (FS—83-32-T, pp 31-45) **Legal provisions of international, national and foreign law with respect to contamination and decontamination.** Bischof, W. Nov 1983. (In German). Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland). (CONF-8306168—).

From 17. annual meeting of Fachverband fuer Strahlenschutz e.V.; Aachen, F.R. Germany (8 Jun 1983).

Considerations of radiation protection aspects with regard to radioactive contamination require due regard to the valid legal provisions concerning radioactive contamination and decontamination. It is to be verified if the regulations in force in the Federal Republic of Germany have proved a success, if they are adequate, practicable and controllable, and if amendments and modifications are to be suggested - in particular with regard to the revision of the Radiation Protection Ordinance. The lecture starts off with an analysis of the respective regulations in the Federal Republic of Germany and how they came into being. Then, the current national regulations are investigated by comparing them to the respective regulations of international radiation protection.

7878 (FS—83-32-T, pp 47-52) **Progress in standardizing the evaluation of contamination, ease of decontamination of surfaces and the effect of decontaminating agents on national and international levels.** Tamberg, T. Nov 1983. (In German). Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland). (CONF-8306168—).

From 17. annual meeting of Fachverband fuer Strahlenschutz e.V.; Aachen, F.R. Germany (8 Jun 1983).

A progress report is given for the standard committees NKe 2.6 (Decontamination of surface), ISO/TC85/SC2/WG9 (Evaluation of contamination) and ISO/TC85/SC2/WG10 (Ease of decontamination). The NKe committee is developing a method of testing allowing the evaluation of the efficiency of substances used in decontaminant solutions (including detergents). Furthermore the committee cooperates with ISO/TC83/SC2/WG10 in the development of an ISO standard 'Ease of decontamination'. ISO/TC85/SC2/WG10 has concentrated its efforts on testing a compromise method containing German and British contributions. Progress is made on the basis of international round robin experiments. ISO/TC85/SC2/WG9 has so far prepared a draft 'Evaluation of contamination' concerning $\beta$-emitters of Esub($\beta$)sup(max) >= 0.15 MeV and $\alpha$-emitters (nearly ready for voting). A similar draft proposal 'Evaluation of Tritium surface contamination' is in the state of having adopted a first group of comments from SC-2-members. The paper describes some important details of new standards and gives an outlook to future developments.

7879 (FS—83-32-T, pp 53-62) **Do the standard values for surface contamination qualify.** Hunzinger, W. Nov 1983. (In German). Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland). (CONF-8306168—).

From 17. annual meeting of Fachverband fuer Strahlenschutz e.V.; Aachen, F.R. Germany (8 Jun 1983).

Derived working limits for surface contamination, like those in Annex 6 of the Swiss Ordinance on Radiation Protection, must be set at a level which ensures that their application will exclude undue external or internal radiation doses. In addition, they have to fulfill another criterium. They must not be too conservative, i.e. the monitoring and the observance of the derived limits shall not give rise to costs so high that the achieved reduction or avoidance of radiation doses no longer justifies the efforts involved. Depending upon the specific properties of the radionuclides, as well as the chemical and physical properties of the contaminant, the following different exposure paths can apply: external irradiation of the skin, transfer to mouth and subsequent ingestion, and inhalation after resuspension. The systematic, quantitative calculation or the resulting radiation doses from all possible exposure paths, as has been done by NRPB for some dozens of representative radionuclides, yields derived working limits for each radionuclide, which are sufficiently conservative and also practicable. Compared to the Radiation Protection Ordinance, the NRPB foresees new parameters and classes of radionuclides: the specific activity of alpha-emitters, surface extension of alpha-contamination, carbon-14 and radionuclides of similar radiotoxicity (new class), tritium and radionuclides of similar radiotoxicity (new class).

7880 (FS—83-32-T, pp 65-76) **Arguments in favour of an indication of measured values in Becquerel per cm$^2$ (Bqcm$^{-2}$) in contamination monitors.** Maushart, R. Nov 1983. (In German). Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland). (CONF-8306168—).

From 17. annual meeting of Fachverband fuer Strahlenschutz e.V.; Aachen, F.R. Germany (8 Jun 1983).

Contamination monitors of today allow an indication of measured values directly in Bqcm$^{-2}$ instead of the usual s$^{-1}$. The main advantages of this improvement are: - the user doesn't need to perform calculations to arrive at values he could compare with permissible limits; - the calibration factors for various nuclides are stored in the monitor and may be called up any time to verify later on the conditions of measurement. Several possibilities to calibrate contamination monitors are discussed. The conclusion is drawn that calibration sources of 10 cm x 10 cm area leading to results always on the safe side, regardless of the detector area. Typical calibration factors for various radionuclides are given.

7881 (FS—83-32-T, pp 153-165) **Problems of contamination and decontamination in handling unsealed radioactive substances in the medical sector.** Gloebel, B.; Andres, C.; Lehnen, H. Nov 1983. (In German). Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland). (CONF-8306168—).

From 17. annual meeting of Fachverband fuer Strahlenschutz e.V.; Aachen, F.R. Germany (8 Jun 1983).

The use of radioactive substances in nuclear medicine causes radiation exposure of patients, personnel, and part of the population. The Radiation Protection Ordinance of the Federal Republic of Germany ensures the protection of individuals and of the public against damage from the radiation of radionuclides. The user therefore has to keep the radiation exposure of persons concerned as low as possible. The variety of applications of radionuclides in therapy, diagnostics and research takes a lot of compromising to comply with this requirement. Undoubtedly, one of the sources of radiation exposure is avoidable or unavoidable contamination. A survey is given an radioactive contamination, solid, liquid, and gaseous, discussing separately relevant and irrelevant circumstances. The resulting radiation exposure is estimated and compared with the maximum possible radiation exposure in normal circumstances. Ways of decontaminating patients, working surfaces, and occupationally exposed personnel are described in normal application and following incidents, distinguishing between preventive and subsequent measures.

7882 (FS—83-32-T, pp 529-535) **$\beta/\gamma$ dosemeters for precautionary radiation measurements in working areas.** Keller, M. Nov 1983. (In German). Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland). (CONF-8306168—).

From 17. annual meeting of Fachverband fuer Strahlenschutz e.V.; Aachen, F.R. Germany (8 Jun 1983).

Precautionary protective measures are necessary when working with unsealed radioactive material. The expected dose equivalents must therefore be assessed before beginning this type of work. The dose equivalent from beta radiation, which can be 1-2 orders of magnitude higher than that from gamma radiation, must also be determined. A small portable instrument (DL 1) with a measuring probe which is easy to handle has been developed at the KFA for this purpose, by means of which the tissue equivalent local dose rate of beta and gamma radiation can be measured. The measuring probe of the DL 1 consists of a small-volume ionization chamber with foil windows and a highly sensitive measuring amplifier. The important measured data for practical radiation protection, the shallow and deep dose equivalents, can thus also be predicted at locations where access is difficult and in inhomogeneous radiation fields, taking residence time into consideration. The skin dose rate - standardized at a tissue depth of 70 $\mu$m - is measured in quasihomogeneous radiation fields without using accessories, the contact does rate in the case with small-area radioactive sources is measured by means of a beta aperture attached to the end window of the chamber and the gamma deep dose rate is measured at a tissue depth of 10 mm by means of a detachable 'gamma dose cap'.

7883 (FS—83-32-T, pp 537-543) **$\beta/\gamma$ multiple finger dosemeters for the statutory determination of skin dose equivalents.** Keller, M. Nov 1983. (In German). Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland). (CONF-8306168—).

From 17. annual meeting of Fachverband fuer Strahlenschutz e.V.; Aachen, F.R. Germany (8 Jun 1983).

A new beta-gamma multiple finger dosemeter has been developed at the KFA for the statutory determination of the skin dose equivalent. In addition to the gamma dose, the beta dose, which is often higher more than one order of magnitude can also be measured by means of this dosemeter with sufficient precision. Measurements of the skin dose using the KFA finger dosemeter take into consideration both the different thickness of the epidermis, with the basal layer sensitive to radiation situated at the lower surface, as well as the penetration depth of the radiation, which in the case of beta radiation is extremely dependent on energy. For this purpose, the KFA finger dosemeters are equipped with a TLD pack with a beta window, consisting of several thermoluminescence detector disks arranged one behind the other. Depending on the application, the TLD pack is incorporated in finger stalls (FD3L), finger bands (FD3B) or finger rings (FD3R). Considerably greater reliability in determining the dose is achieved by equipping the KFA finger dosemeters with several detector disks. In the case of high doses valuable additional information is provided for the effective dose-equivalent calculations then necessary as well as possible measures to be undertaken.

7884 (FS—83-32-T, pp 545-554) **Local dose rates in front of contaminated surfaces.** Heinzelmann, M. Nov 1983. (In German). Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland). (CONF-8306168—).

From 17. annual meeting of Fachverband fuer Strahlenschutz e.V.; Aachen, F.R. Germany (8 Jun 1983).

The dose rate in front of contaminated surfaces is unexpectedly high in many cases, since ionizing radiation is not shielded. The high dose rates are caused primarily by $\beta$-radiation. For example, the $\beta$-dose rate is approximately 100 $\mu$Sv/h (10 mrem/h) at a distance of 1 cm in front of a large surface contaminated with 37 Bq/cm$^2$ (corresponding the limit of surface contamination in controlled areas). In comparison, the $\gamma$-dose rate can be generally neglected. It amounts to only about 2.5 $\mu$Sv/h (1/4 mrem/h) at a distance of 1 cm in front of a circular surface of 1 m diameter contaminated with 37 Bq/cm$^2$ ($10^{-3}$ $\mu$Ci/cm$^2$). For determining the dose rate in front of contaminated surfaces, this dose rate was calculated for $\beta$-emitters of different maximum energy and for various distances from contaminated surfaces of different size. The results are compiled in diagrams. These values are of particular significance, since suitable dosemeters for $\beta$-radiation are not yet used very often in practice.

7885 (INIS-mf—9071, pp 16) **International intercomparison to increase the reliability of radioactivity measurements.** Szoerenyi, A.; Vagvoelgyi, J.; Zsinka, A. (Orszagos Meresuegyi Hivatal, Budapest (Hungary)). 1984. (In Hungarian). NTIS (US Sales Only), PC A04/MF A01. File Number TI85780132. (CONF-8404195—Summ.).

From Training course on radiation protection; Balatonkenese, Hungary (11 Apr 1984).

7886 **(INIS-mf—9090) Ionization chambers for phantom measurement.** Severa, I. (Tesla, Premysleni (Czechoslovakia). Vyzkumny Ustav Pristroju Jaderne Techniky). Nov 1983. 20p. (In Czech). NTIS (US Sales Only), PC A02/MF A01. File Number DE85780144.

The specifications required for designing an ionization chamber for measuring the depth dose distribution and dose rates in phantom material are presented. The chamber should be circular or cylindrical to provide minimal directional dependence. Thermoplastic tissue-equivalent materials are suitable for the chamber walls. The dimensions of the sensitive volume are chosen from 10 cm$^3$ to 10 mm $^3$ in view of possible exposures from 30 nGys$^{-1}$ to 300 mGys$^{-1}$. Tables show suitable insulation materials available in Czechoslovakia and data on manufactured ionization chambers and the specifications of prospective types and their dosimetric properties.

7887 (INIS-mf—9091, pp 54-57) **Branch standard centre for radionuclide metrology and isotope production standardization in Czechoslovakia.** Brabec, D. (Ustav pro Vyzkum, Vyrobu a Vyuziti Radioisotopu, Prague (Czechoslovakia)). 1982. (In Czech). NTIS (US Sales Only), PC A08/MF A01. File Number TI85780139. (CONF-821288—).

From National seminar on the system of scientific and technical information for the Czechoslovak nuclear programme; Jihlava, Czechoslovakia (7 Dec 1982).

The tasks are described of the branch standardization centre. The principal information sources are listed in the field of technical standardization as are the methods of the processing and use of these sources for the compilation of technical standards.

7888 **(INIS-mf—9091) System of scientific and technical information for the Czechoslovak nuclear programme. Proceedings of national seminar.** (Ceskoslovenska Vedeckotechnicka Spolecnost, Prague. Dum Techniky). 1982. 166p. (In Czech). (CONF-821288—). NTIS (US Sales Only), PC A08/MF A01. File Number DE85780139.

From National seminar on the system of scientific and technical information for the Czechoslovak nuclear programme; Jihlava, Czechoslovakia (7 Dec 1982).

Items within the scope of EDB have been entered individually into the data base. (ACR)

7889 **(INIS-mf—9402) Radiation safety act amendment Act 1979 no. 20 of 1979.** (Western Australia). 30 Aug 1979. 3p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85780187.

This Act amends Section 32 of the Radiation Safety Act 1975 which concerns the refusal of a licence, exemption or registration for any radioactive substance, irradiating apparatus or electronic equipment. The amendments cover additional specifications warranting such a refusal, with due regard to recommendations and guidelines on radiation protection issued by certain international bodies.

7890 **(INIS-mf—9403) Radiation Protection and Control Act, 1982 (South Australia) No.49 of 29 April 1982.** (Australia). 29 Apr 1982. 23p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85780188.

This Act provides for the control of activities related to radioactive substances and radiation apparatus as well as for protection against the harmful effects of ionizing radiation. It also amends the Health Act, 1935-1980 by deleting certain provisions concerning, inter alia, radioactive substances and radiation apparatus. The Act states as its general objective that the competent authorities in the exercise of their duties and any person carrying on activities involving radioactive substances and equipment emitting ionizing radiation shall try to ensure that exposure of persons to ionizing radiation is kept as low as reasonably achievable, social and economic factors being taken into account (the ALARA principle recommended by the International Commission on radiological Protection).

7891 **(INIS-mf—9409) Regulations of 1 March 1983 relating to production, imports and sales of radioisotopes.** (Norway). 1 Mar 1983. 2p. (In English and Norwegian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85780184.

These regulations were issued by the Ministry of Health and Social Affairs, pursuant to the Act of 19th June 1938 on the use of radium and X-rays etc. The Regulations came into force on the date they were issued. They apply to radioisotopes used for industrial, commercial, agricultural, medical and scientific purposes.

7892 **(PNL-SA—12407) Portable dose equivalent meter based on microdosimetry.** Braby, L.A. (Pacific Northwest Lab., Richland, WA (USA)). Nov 1984. Contract AC06-76RL01830. 19p. (CONF-841117—23). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003636.

From 8. conference on the application of accelerators in research and industry; Denton, TX, USA (12 Nov 1984).

It is generally accepted that the physical basis of the relative biological effectiveness of different radiations is the difference in the spatial distribution of ionization along the charged particle tracks. Thus it is possible to measure physical quantities which may be related to biological damage, and use them to estimate the radiation protection quantity dose equivalent. A prototype instrument utilizing a spherical proportional counter and a microcomputer to make such measurements has been developed and tested. The detector is filled with gas at low pressure in order to simulate micrometer diameter volumes of tissue. Energy deposition in these small volumes is a stochastic quantity which depends on charged particle stopping power, path length through the site, energy loss straggling, and energy transport by secondary charged particles (delta rays). To the extent that the energy deposition in the site is proportional to the geometric chord length distribution, energy deposition can be used to determine the linear energy transfer. The mean quality factor can then be calculated on the basis of the current definition. The prototype instrument uses two amplifiers, with gains of 50 and 1000, processing the pulses from a single detector in order to resolve the wide range of energy deposition events produced by neutron and gamma irradiation. Each amplifier is connected to a specially designed analog to digital converter and a 128 channel multichannel analyzer. A microcomputer controls the system and calculates dose and dose equivalent. Test results for a variety of accelerator produced neutron irradiations show that, from 0.1 to 15 MeV, system accuracy is +-0.5 for anti Q and +-15% for dose equivalent. 9 references, 3 figures, 2 tables.

7893 **Neutron fluence-to-dose equivalent conversion factors: a comparison of data sets and interpolation methods.** Sims, C.S.; Killough, G.G. (Oak Ridge National Lab., TN). *Radiation Protection Dosimetry;* **5**: No. 1, 45-48(1983). Contract W-7405-ENG-26.

Various segments of the health physics community advocate the use of different sets of neutron fluence-to-dose equivalent conversion factors as a function of energy and different methods of interpolation between discrete points in those data sets. The major data sets and interpolation methods are used to calculate the spectrum average fluence-to-dose equivalent conversion factors for five spectra associated with the various shielded conditions of the Health Physics Research Reactor. The results obtained by use of the different data sets and interpolation methods are compared and discussed.

## 6560 Solid State Physics

*REFER ALSO TO CITATION(S) 6560007179*

7894 **(BNL—35371) Dynamical effects and the critical behavior of Random-Field Systems (invited).** Shapir, Y. (Brookhaven National Lab., Upton, NY (USA)). 1984. Contract AC02-76CH00016. 23p. (CONF-841184—13). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003209.

From 30. annual conference on magnetism and magnetic materials; San Diego, CA, USA (27 Nov 1984).

A variety of phemonena is observed experimentally in random-field (RF) systems realized by the application of an external field to diluted antiferromagnets. At low temperatures, infinitely long hysteric effects are manifested by the history dependence of the final states: long-range order is observed if the field is applied after final states, while domain-states are reached when field-cooled. While no indications for critical fluctuations are detected in 2d systems, scaling behavior, for both the correlation length and the specific-heat, is observed in 3d systems over an intermediate range of temperatures. The related critical properties seem to be well described by the corresponding ones in the 2d pure Ising model. The renormalization-group approach, which yields for the equilibrium critical exponents their values of the pure model in d-2 dimensions, is reviewed. A generalization of the dimensional-reduction approach, which accounts self-consistently for renormalized responses of the RF system, is presented. The dynamical effects are implicitly incorporated through the variation in the critical response between the local and the global regimes, associated with short and long time scales, respectively. In both regimes the lower critical dimension is found to be $d = 2$ in accordance with stability arguments. The short-time critical behavior indicates a dimensional-reduction by one for the 3d thermal exponents, in agreement with the experimental results. 36 references.

7895 **Effect of temperature-dependent energy-level shifts on a semiconductor's Peltier heat.** Emin, D. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Physical Review [Section] B: Condensed Matter;* **30**: No. 10, 5766-5770(15 Nov 1984).

The Peltier heat of a charge carrier in a semiconductor is calculated for the situation in which the electronic energy levels are temperature dependent. The temperature dependences of the electronic energy levels, generally observed optically, arise from their dependences on the vibrational energy of the lattice (e.g., as caused by thermal expansion). It has been suggested that these temperature dependences will typically have a major effect on the Pel-

tier heat. The Peltier heat associated with a given energy level is a thermodynamic quantity; it is the product of the temperature and the change of the entropy of the system when a carrier is added in that level. As such, the energy levels cannot be treated as explicitly temperature dependent. The electron-lattice interaction causing the temperature dependence must be expressly considered. It is found that the carrier's interaction with the atomic vibrations lowers its electronic energy. However, the interaction of the carrier with the atomic vibrations also causes an infinitesimal lowering ($\sim 1/N$) of each of the N vibrational frequencies. As a result, there is a finite carrier-induced increase in the average vibrational energy. Above the Debye temperature, this cancels the lowering of the carrier's electronic energy. Thus, the standard Peltier-heat formula, whose derivation generally ignores the temperature dependence of the electronic energy levels, is regained. This explains the apparent success of the standard formula in numerous analyses of electronic transport experiments.

7896 **Mean-field simulation of field-induced domains and hysteretic behavior in dilute Ising antiferromagnets.** Yoshizawa, H.; Belanger, D.P. (Brookhaven National Laboratory, Upton, New York 11973). *Physical Review [Section] B: Condensed Matter;* **30**: No. 9, 5220-5227(1 Nov 1984).

A mean-field free-energy surface of a dilute Ising antiferromagnet on two-, three-, and four-dimensional lattices is studied numerically as a function of temperature and an applied magnetic field. In the presence of the field parallel to spins, the dilute Ising antiferromagnet is believed to map onto the random-field Ising model providing a convenient experimental realization. From the hysteretic behavior we identify three temperature regions: (1) a high-temperature equilibrium region above the hysteresis boundary T/sub H/ where an accessed state is independent of the sample history; (2) a low-temperature region below T/sub c/ where the antiferromagnetic state has the lowest free energy; (3) an intermediate-temperature region T/sub c/<T<T/sub H/ where the accessed state depends on the sample history, but the domain state has a lower free energy than the antiferromagnetic state. When the sample is cooled in a finite field, the domains are formed and stabilized below T/sub H/. Thus the antiferromagnetic state is inaccessible in our simulation. In contrast, once the antiferromagnetic order is prepared at low temperatures and the temperature is raised in the finite field, the sample remains in the antiferromagnetic state until T/sub c/ and then the domains nucleate above T/sub c/, and finally the sample recovers the high-temperature equilibrium state at T/sub H/. In recent neutron scattering experiments on three-dimensional (3D) Ising antiferromagnets, the analogous behavior is observed.

7897 **Spectral dimension of elastic Sierpinski gaskets.** Liu, S.H. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physical Review [Section] B: Condensed Matter;* **30**: No. 7, 4045-4047(1 Oct 1984).

The spectral dimension of an elastic Sierpinski gasket with nearest-neighbor central forces has been found to be d = 2 ln3/ln6, which is different from d = 2 ln3/ln5 for the isotropic force model. This result lends support to the argument that the two force models belong to two distinct universality classes.

## 6561 Superconductivity

*REFER ALSO TO CITATION(S) 6561007074, 7096, 7124, 7145, 7160, 7161, 7162*

7898 **(KFK—3722) Tunneling spectroscopy on superconducting $Nb_3Sn$ with artificial barriers.** Schneider, U. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Angewandte Kernphysik 1; Karlsruhe Univ. (T.H.) (Germany, F.R.). Fakultaet fuer Physik). Mar 1984. 96p. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE84752324.

Tunneling diodes on $Nb_3Sn$ were prepared by magnetron sputtering. The superconducting transition temperatures of the $Nb_3Sn$ films were in the range of 5 to 18 K. An energetically low-lying structure in the tunneling density of states has been localized by detailed studies of the second derivative of the current-voltage characteristics of the diodes. This structure was found near 5.5 meV for stoichiometric $Nb_3Sn$ (Tsub(c) approx.= 18 K) and at 6.7 meV for understoichiometric $Nb_3Sn$ (Tsub(c) approx.= 5 K). The minimum in the conductance at zero energy found in the normal state could be identified to be mainly due to inelastic phonon processes of barrier phonons and $Nb_3Sn$ phonons. Deformations were found in the tunneling density of states of stoichiometric $Nb_3Sn$ diodes which lead to contradiction when explained by proximity effects.

7899 **Spin susceptibility and spin-spin relaxation in superconductors.** Fedro, A.J.; Robinson, J.E. (Materials Science and Technology Division, Argonne National Laboratory, Argonne, Illinois 60439 and Northern Illinois University, DeKalb, Illinois 60115). *Physical Review [Section] B: Condensed Matter;* **30**: No. 9, 5336-5338(1 Nov 1984).

It is shown that the conduction-electron spin susceptibility chi(r) and thus the indirect interaction between magnetic impurities in superconductors can lead to new behavior in very dilute systems that is absent at higher impurity concentrations and that is compatible with recent experiment. In the superconducting state we find that chi(r) decays exponentially at all r, the spin-spin coupling can be antiferromagnetic at intermediate r, and the spin-spin relaxation rate depends markedly on Fermi-surface anisotropy.

7900 **Flux-line-cutting and flux-pinning losses in type-II superconductors in rotating magnetic fields.** Clem, J.R.; Perez-Gonzalez, A. (Ames LaboratoryU.S. Department of Energy and Department of Physics, Iowa State University, Ames, Iowa 50011). *Physical Review [Section] B: Condensed Matter;* **30**: No. 9, 5041-5047(1 Nov 1984). Contract W-7405-ENG-82.

A general critical-state theory, including the effects of both flux-line cutting and flux pinning, is proposed for calculations of hysteresis in type-II superconductors in parallel applied magnetic fields that vary in both magnitude and direction. In this theory, if the magnitude of the electrical-current-density component perpendicular to the magnetic induction B exceeds the corresponding critical value J/sub c/perpendicular, depinning occurs, and an electric field component E/sub perpendicular/ perpendicular to B appears; if the magnitude of the current-density component parallel to B exceeds the corresponding critical value J/sub c/para, flux-line cutting occurs, and an electric field component E/sub p/ara parallel to B appears. Model calculations are performed to solve for the electrodynamic response of a slab subjected to a parallel, constant magnetic field whose direction undergoes either continuous rotation or periodic oscillation. The relation of the theory to the pioneering experiments of LeBlanc and co-workers is discussed.

## 6570 Theoretical Physics

*REFER ALSO TO CITATION(S) 6570007263, 7580, 7670, 7671, 7690, 7857, 7858, 7894*

7901 **(DOE/ER/13145—T1) Magnetostatic problems in nonlinear media with hysteresis. Progress report.** Mayergoyz, I.D. (Maryland Univ., College Park (USA)). 1984. Contract AS05-84ER13145. 4p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85003701.

The scope of the investigations undertaken under the contract, since the beginning of the current term is comprised of: mathematical models for scalar hysteresis nonlinearities, boundary Galerkin's approach for the solution of exterior field problems, development and testing of a new quasi-finite element discretization technique based on the boundary Galerkin approach, and investigation of new iterative methods for the solution of discrete Bellman equations and quasi-variational inequalities.

7902 **(IC—84/5) Moessbauer experiment to observe significance of vector potentials in quantum theory.** Cheon, I.T. (International Centre for Theoretical Physics, Trieste (Italy)). Feb 1984. 14p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700094.

As a powerful method to confirm the Aharonov-Bohm effect in bound states, we propose the Moessbauer experiment with $_{53}I^{129}$ nucleus fixed at the center of toroidal magnet. With a toroid

of major radius 10 cm, minor radius 1.5 cm and 6000 turns of coil, we estimate the energy shift -1.1x10$^{-8}$eV for the electric current of 1 mA.

7903 **(IC—84/15) SU(3)xSU(2)xU(1) invariant compactifying solutions to 11-dimensional supergravity.** Randjbar-Daemi, S.; Salam, A.; Strathdee, J. (International Centre for Theoretical Physics, Trieste (Italy)). Feb 1984. 22p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700095.

A five-parameter class of quotient spaces, SU(3)xSU(2)xU(1)/SU(2)xU(1)xU(1), is described. All of these spaces admit an Einstein metric. In the context of spontaneous compactification of eleven-dimensional supergravity, the metrical scales are determined by the five parameters characterizing the space and the expectation value of the field strength Fsub(ABCD). Harmonic expansions are described, and it is shown that none of these spaces can account for the SU(3)xSU(2)xU(1) quantum numbers of even a single generation of quarks and leptons. This is in addition to the well-known chirality difficulty.

7904 **(IC—84/21) Towards a self-consistent computation of vacuum energy in 11-dimensional supergravity.** Randjbar-Daemi, S.; Salam, A.; Strathdee, J. (International Centre for Theoretical Physics, Trieste (Italy)). Feb 1984. 16p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700096.

An attempt is made to balance the negative vacuum energy associated with the Freund-Rubin compactification of the 11-dimensional supergravity theory against the contribution from vacuum fluctuations. We do this in order to obtain a ground state geometry which has four physical (flat) dimensions and is of the form (Minkowski)$^4$xB$^7$ where B$^7$ is one of the 7-dimensional manifolds: S$^7$, S$^5$xS$^2$, S$^4$xS$^3$, CP$^2$xS$^3$, S$^3$xS$^2$xS$^2$ or a 5-parameter family of SU(3)xSU(2)xU(1) invariant spaces Msup(pqrst). We find that all of these solutions are unstable. As a side-issue the facility for computation of the particle spectra, which results from the use of lightcone gauge, is emphasized.

7905 **(INFN/AE—83-1) Are classical tachyons slower-than-light quantum particles.** Recami, E.; Maccarrone, G.D. (Istituto Nazionale di Fisica Nucleare, Catania (Italy)). 1983. 8p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700097.

After having studied the shape that a tachyon T (e.g., intrinsecally spherical) would take up, it is shown in an explicit example that the characteristic of classical tachyons are similar to those of the ordinary (slower-than-light) quantum particles. In particular, a realistic tachyon is associated with a 'phase-speed' V [$V^2 > C\sigma 2$], but with a 'group speed' $v = c^2/V$ [$v^2 < c^2$].

7906 **(IPP—6/219) Energy conserving non-relativistic guiding center mechanics and the Galilean principle of relativity.** Wimmel, H.K. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). Mar 1983. 25p. NTIS (US Sales Only), PC A02/MF A01. File Number DE84752308.

Arguments and representative examples are given that suggest that exact energy conservation and Galilei invariance are incompatible in non-relativistic guiding-center mechanics. Provided that this is true in general it also follows that exact energy conservation and Lorentz invariance are incompatible in relativistic guiding-center mechanics. It would furthermore follow that ever guiding-center mechanics with exact energy conservation is a non-unique theory owing to the principle of relativity. The paper also presents a Galilei invariant guiding-center mechanics that does not conserve energy.

7907 (Juel-Spez—255, pp 79-80) **Averaging in iterative Hartree-Fock solving procedures.** Klemt, V. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

7908 (Juel-Spez—255, pp 104) **Extended time-dependent mean-field theories from the maximum entropy principle.** Reinhardt, H.; Balian, R.; Alhassid, Y. Apr 1984. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750011.

In Kernforschungsanlage Juelich, Institut fuer Kernphysik: Annual report 1983.

7909 **(KFKI—1983-110) Quantization of spacetime and the corresponding quantum mechanics.** Banai, M. (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). Nov 1983. 39p. NTIS (US Sales Only), PC A03/MF A01. File Number DE84703183.

An axiomatic framework for describing general space-time models is outlined. Space-time models to which irreducible propositional systems belong as causal logics are quantum(q) theoretically interpretable and their event spaces are Hilbert spaces. As a basic assumption, the time t and the radial coordinate r of a q particle satisfy the CCR $(t, r) = +\text{-}i(h/2\pi)$. The two cases will be considered simultaneously. In that case the even space is the Hilbert space $L^2(IR^3)$. Unitary symmetries consist of Poincare-like symmetries: translations, rotations and inversion, and of gauge-like symmetries. Space inversion implies the time inversion. This q space-time reveals a confinement phenomenon: the q particle is 'confined' in a $(h/2\pi)$ size region of Minkowski space IM$^4$ at any time. One particle mechanics over q space-time provides mass eigenvalue equations for elementary particles. Prugovecki's stochastic q mechanics and q space-time offer a natural way for introducing and interpreting consistently such a q space-time and q particles living in it. The mass eigenstates of q particles generate Prugovecki's extended elementary particles. When $(h/2\pi) \rightarrow 0$, these particles shrink to point particles and IM$^4$ is recovered as the classical (c) limit of q space-time. Conceptual considerations prefer the case $(t, r) = +i(h/2\pi)$ and applications in hadron physics give the fit $(h/2\pi)$ approx.2/5 fermi/GeV.

7910 **(LBL—18569) Quantum mechanical and semiclassical approaches to molecular dynamics.** Shi, S. (Lawrence Berkeley Lab., CA (USA)). Sep 1984. Contract AC03-76SF00098. 143p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE85003458.

A new multichannel exchange kernel formalism for reactive scattering is introduced. The central feature of the method is the expansion of the reactive scattering wavefunction in terms of the non-reactive coupled-channel scattering waves in all of the arrangements. The exact S matrix is found from the non-reactive wavefunction and the exchange kernel which are computed from the non-reactive coupled-channel scattering calculations in each arrangement. An approximate version of formula is obtained by virtue of the distorted wave Born approximation (DWBA) where the non-reactive coupled-channel scattering wavefunction is utilized for distorted waves. Application to a standard test problem (collinear $H+H_2$) shows that multichannel DWBA is extremely accurate if the reaction probability is no larger than 0.1 and if $\sim$ 3 to 4 vibrational states are included in the non-reactive coupled channel expansion, and that the full exact calculation is stable, accurate and easy to implement. Semiclassical perturbation theory combined with two approximate models for polyatomic Hamiltonian - the reaction path model and the kinetic coupling model - leads to extremely simple, analytical formulae for S-matrix and the spectra of overtone. The numerical tests indicate that these simple approximate methods are of useful accuracy. A new semiclassical approach is proposed. In this approach the evolution of the states of a system, which are parameterized by label variables, is determined by calculating the time development of the label variables classically. The formalism for calculating the S-matrix within this framework is developed. Sample calculations show that this method is very simple and describes quantum phenomena very well. 12 figures, 12 tables.

7911 **(ORNL—6073) Initial velocity of the emerging free boundary in a two-phase Stefan problem with imposed flux.** Solomon, A.D.; Alexiades, V.; Wilson, D.G. (Oak Ridge National Lab., TN (USA)). Nov 1984. Contract AC05-84OR21400. 33p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85003813.

Consider the one-dimensional, two-phase Stefan Problem with an imposed flux in which the phase change front originates at the material boundary. We prove that, subject to suitable assumptions on the initial temperature and imposed flux, the initial speed of the phase change front is equal to the jump between the surface and initial fluxes at the boundary. Similarly, we prove that the front X(t) is continuously differentiable in the closed interval $[0,t^*)$ for some $t^* > 0$.

7912 **(UWThPh—84-30) Stochastic quantization and gauge-fixing of the linearized gravitational field.** Hueffel, H.; Rumpf, H. (Vienna Univ. (Austria)). 1984. 35p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85700098.

Due to the indefiniteness of the Euclidean gravitational action the Parisi-Wu stochastic quantization scheme fails in the case of the gravitational field. Therefore we apply a recently proposed modification of stochastic quantization that works in Minkowski space and preserves all the advantages of the original Parisi-Wu method; in particular no gauge-fixing is required. Additionally stochastic gauge-fixing may be introduced and is also studied in detail. The graviton propagators obtained with and without stochastic gauge-fixing all exhibit a noncausal contribution, but apart from this effect the gauge-invariant quantities are the same as those of standard quantization.

7913 **Simulation of a critical Ising fractal.** Bhanot, G.; Neuberger, H.; Shapiro, J.A. (The Institute for Advanced Study, Princeton, New Jersey 08540). *Physical Review Letters;* **53**: No. 24, 2277-2280(10 Dec 1984).

The results of a microcanonical simulation of an Ising model defined on a truncated, lattice-embedded, fractal Sierpinsky carpet of dimension ~1.86 are presented. Estimates for a variety of exponents give, via hyperscaling at criticality and via the behavior of the spin-spin correlation away from criticality, consistently, a dimension ~1.66 +- 0.10.

7914 **Positive-energy theorem for $R+R^2$ gravity.** Strominger, A. (The Institute for Advanced Study, Princeton, New Jersey 08540). *Physical Review [Section] D: Particles and Fields;* **30**: No. 10, 2257-2259(15 Nov 1984).

We prove that asymptotically flat extrema of the action $S = \int [R+(1/2\beta^2)R^2]$ have non-negative energy, provided there exists a spacelike hypersurface on which $R>-\beta^2$. Flat space is shown to be the unique topologically Minkowskian stationary point of the energy. This result leads to a heuristic functional variational argument for positivity that does not involve restrictions on R. We also prove that flat space is semiclassically stable. Possible extensions of the theorems and relevance to quantum gravity are briefly discussed.

7915 **Spectral broadening of ultrashort pulses in a nonlinear medium.** Yang, G.; Shen, Y.R. (Department of Physics, University of California, Berkeley, California 94720). *Optics Letters;* **9**: No. 11, 510-512(Nov 1984). Contract AC03-76SF00098.

Spectral superbroadening of ultrashort-pulse propagation in a nonlinear medum is calculated by solving the nonlinear-wave equation exactly. The effects of four-wave mixing and pulse deformation on phase modulation are included. The results yield on asymmetric Stokes-anti-Stokes broadening in fair agreement with experimental observation.

7916 **Curvature effects in interferometry.** Anandan, J. (Max Planck-Institut fuer Physik und Astrophysik, Werner Heisenberg-Institut fuer Physik, D-8000 Muenchen 40, Federal Republic of Germany). *Physical Review [Section] D: Particles and Fields;* **30**: No. 8, 1615-1624(15 Oct 1984).

The phase shift in interferometry due to the space-time curvature is computed in nonrelativistic and relativistic physics. This treatment is applied to an interferometer analogous to the perfect crystal interferometer used in the Colella-Overhauser-Werner experiment with thermal neutrons, an interferometer consisting of only horizontal mirrors, suitable for ultracold neutrons, and optical interferometry. Experiments are proposed to detect the effect of the tidal forces of the Earth, Moon, and the Sun, for the first time in interferometry. The phase shift in neutron interferometry due to terrestrial objects is considered and an experiment is proposed with superfluid helium as the source of gravity. This would provide, for the first time, direct evidence concerning the gravitational interaction between two quantum-mechanical states. The possibility of detecting purely general-relativistic effects due to curvature, by means of neutron interferometry, is also explored.

7917 **Transition to chaos by interaction of resonances in dissipative systems. I. Circle maps.** Jensen, M.H.; Bak, P.; Bohr, T. (H. C. Orsted Institute, Universitetsparken 5, DK-2100 Copenhagen O, Denmark). *Physical Review [Section] A: General Physics;* **30**: No. 4, 1960-1969(Oct 1984). Contract AC02-76CH00016.

Dissipative dynamical systems with two competing frequencies exhibit transitions to chaos. We have investigated the transition through a study of discrete maps of the circle onto itself. The transition is caused by interaction and overlap of mode-locked resonances and occurs at a critical line where the map loses invertibility. At this line the mode-locked intervals trace up a complete devil's staircase whose complementary set is a Cantor set with fractal dimension D~0.87. Numerical results indicate that the dimension is universal for maps with cubic inflection points. Below criticality the staircase is incomplete, leaving room for quasiperiodic behavior. The Lebesgue measure of the quasiperiodic orbits seems to be given by an exponent $\beta \sim 0.35$ which can be related to D through the scaling relation $D = 1-\beta/\nu$. The exponent $\nu$ characterizes the cutoff of narrow plateaus near the transition. A variety of other exponents describing the transition to chaos is defined and estimated numerically.

7918 **Transition to chaos by interaction of resonances in dissipative systems. II. Josephson junctions, charge-density waves, and standard maps.** Bohr, T.; Bak, P.; Jensen, M.H. (Laboratory of Atomic and Solid State Physics, Cornell University, Ithaca, New York 14853). *Physical Review [Section] A: General Physics;* **30**: No. 4, 1970-1981(Oct 1984). Contract AC02-76CH00016.

We have studied the transition to chaos caused by interaction and overlap of resonances in some condensed-matter systems by constructing and analyzing appropriate return maps. In particular, the resistively shunted Josephson junction in microwave fields and charge-density waves in rf electric fields may be described by the differential equation of the damped driven pendulum in a periodic force. The two-dimensional return map for this equation is shown to collapse to a one-dimensional circle map in a parameter regime including the transition to chaos. Phase locking, noise, and hysteresis in these systems can thus be understood in a simple and coherent way by taking over theoretical results for the circle map, some of which were derived in the preceding paper. In order to understand the contraction to one dimensionality we have studied the two-dimensional Chirikov standard map with dissipation. A well-defined transition line along which the system exhibits circle-map critical behavior was found. At this line the system is always phase locked. We conclude that recent theoretical results on universal behavior can readily be checked experimentally by studying systems in condensed-matter physics. The relation between theory and experiment is simple and direct.

## 6580 Mathematical Physics

7919 **(BNL—35384) Simulation of estimating periodicity of seasonally stationary time series.** Tian, C.J. (Brookhaven National Lab., Upton, NY (USA)). Jun 1984. Contract AC02-76CH00016. 30p. (CONF-840855—1). NTIS, PC A03/MF A01; GPO Dep. File Number DE85003517.

From International conference on energy modelling and simulation; Minneapolis, MN, USA (13 Aug 1984).

Herein, some common periodicity estimation methods: the periodogram analysis, the maximum entropy spectral method, the successive average method as well as the graphic method are considered. For comparing these methods and verifying their practical efficiency, simulations are performed on several groups of seasonal stationary time series which are generated by the model $x(t) = v(t) + z(t)$. v(t) being a seasonal component with different forms (Sinusoid, unequal amptitude oscillation, slope signal, exponential decay

signal and block signal etc.) and z(t) being autoregressive process under different levels of signal-noise ratio. Computational results, comprehensively illustrate that the successive average method is easier to carry out and more efficient in practice.

7920 **(LBL—18634) Nonlinear $\sigma$-models and integration methods.** Ntagwirumugara, E. (Lawrence Berkeley Lab., CA (USA)). Nov 1984. Contract AC03-76SF00098. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004447.

We present a brief review of two integration methods- the inverse scattering problem methods and the Baecklund transformations - for the U(n) principal $\sigma$-models.

7921 **(SAND—84-2189) Solution of structured non-stiff ODEs.** Shampine, L.F. (Sandia National Labs., Albuquerque, NM (USA)). Nov 1984. Contract AC04-76DP00789. 20p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004137.

The solution of the initial value problem for a system of ordinary differential equations (ODEs), $y' = f(x,y)$, by Runge-Kutta methods is considered. The structure to be exploited is that a large portion of the cost of evaluating f(x,y) arises in the evaluation of functions of the independent variable x only. It is shown that when the structure is favorable, there are methods which are considerably more efficient than those currently used in general purpose codes.

7922 **(UCID—20271) Bayesian analysis of time series I: Householder transformation analyses.** Gersch, W. (Lawrence Livermore National Lab., CA (USA)). Nov 1984. Contract W-7405-ENG-48. 53p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85004449.

A smoothness priors-Bayesian analysis method for the analysis of stationary and nonstationary time series is shown. The method is applied to the estimation of the mean value function of a nonstationary time series, the estimation of the impulse response from not necessarily stationary data, the estimation of the power spectral density from a short duration time series and the estimation of the transfer function between input and output data, for short segments of stationary time series. Each problem is cast as an ordinary least squares problem with particular stochastic constraints. The stochastic constraints have an interpretation as a prior distribution on the unknown model parameters. The critical computation of the likelihood of the Bayesian model is done using a Householder transformation least squares algorithm.

# 70 FUSION ENERGY

7923 **(JAERI-M—83-182) Annual report of the Fusion Research Center for the period of April 1, 1982 to March 31, 1983.** (Japan Atomic Energy Research Inst., Tokyo). Nov 1983. 235p. NTIS (US Sales Only), PC A11/MF A01. File Number DE85700103.

Research and development activities of the Fusion Research Center (Department of Thermonuclear Fusion Research and Department of Large Tokamak Development) from April 1982 to March 1983 are described. The JFT-2 tokamak was shutdown after 10 years operation. Operation test of a new device JFT-2M was near completion. In the joint JAERI-USDOE experiment on Doublet-III a record value of beta, 4.6 %, was achieved. Major efforts in theory and computation was on high beta tokamak stability, second stability regions being found for low m internal modes. The JT-60 program progressed as scheduled, installation of the tokamak machine being initiated in February 1983. A 100 kV test was completed of prototype unit for JT-60 NBI. In the development of a high power klystron for JT-60 LH heating, a test fabricated tube generated 1 MW, 10 s RF pulses. Development of TiC coatings for JT-60 first wall was successfully concluded. In the superconducting magnet technology, the Japanese coil for IEA Large Coil Task was installed in a test facility at ORNL after successful performance test at Naka site. A 10 T experiment of a $Nb_3Sn$ coil with 60 cm inner bore was made. Construction of the Tritium Process Laboratory was started in February 1983. Design studies of the Fusion Experimental Reactor and INTOR were continued.

## 7001 Plasma Research

*REFER ALSO TO CITATION(S) 7001007562, 7581, 8017, 8022, 8023*

7924 **(DOE/DP/40124—69) Nonlinear saturation of stimulated Raman scattering in homogeneous plasma.** McKinstrie, C.J.; Simon, A.; Williams, E.A. (Rochester Univ., NY (USA). Lab. for Laser Energetics). Apr 1984. Contract AC08-80DP40124. 30p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85003120.

Nonlinear saturation of the stimulated Raman scattering instability is considered in an infinite homogeneous plasma. The incident wave amplitude exceeds its threshold value by the fractional amount $\Delta$ ($<< 1$). A single backscattered electromagnetic wave and a single plasma wave grow until time-asymptotic saturation occurs. The squared amplitude and nonlinear frequency shift of each wave are determined by secular-free perturbation theory and are proportional to $\Delta$. The saturation mechanism is identified and the reflection coefficient determined. Both saturation amplitudes are shown to be stable to small deviations from their time-asymptotic values.

7925 **(DOE/DP/40175—1) Design, construction and initial evaluation of an absolute, time-integrating/time-resolving spectrometer for the diagnostics of pulsed, high temperature plasma x-ray sources in the 100-10,000 eV region.** Henke, B.L. (Hawaii Univ., Honolulu (USA). Dept. of Physics and Astronomy). Oct 1984. Contract AS08-82DP40175. 142p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE85003526.

A new spectrograph system has been developed and calibrated in this laboratory for the absolute spectrometry of high intensity pulsed x-ray sources in the 100 to 10,000 eV region. This spectral region is analyzed with fixed elliptically curved crystals and molecular multilayers of 2d-values in the 3 to 160 A range. Twin channels are utilized for simultaneous time-integrated photographic recording and for time-resolved x-ray streak camera recording. Absolute calibrations of the elliptical analyzers, of the photographic film, and of the gold and CsI transmission photocathodes have been made using monoenergetic, CW laboratory x-ray sources. The overall transmission characteristics of the spectrograph have also been determined. The instrument has been designed for mounting through a pneumatically-controlled high-vacuum valve onto a four-inch port of a one-meter diameter source chamber and includes an appendage, high-vacuum, sputter/ion pre-pumping station. The initial testing and application of this new spectrographic system has been on the University of Rochester's LLE 24-laser-beam OMEGA source.

7926 **(DOE/ER/53173—T1) Fluctuations and transport in fusion plasmas. Annual progress report, October 1, 1983-September 30, 1984.** Gould, R.W. (California Inst. of Tech., Pasadena (USA)). 1984. Contract FG03-84ER53173. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003612.

This grant supports an integrated program of experiment and theory in tokamak plasma physics. Emphasis is placed on microscopic fluctuations and anomalous transport. The primary objective is to characterize the properties of the microscopic fluctuations observed in tokamaks and to try to develop an understanding of the fluctuation-induced transport of particles and heat. Anomalous transport, which causes energy losses one to two orders of magnitude larger than predicted by neoclassical transport theory, occurs in all tokamaks and underlies empirical scaling laws.

7927 **(DOE/ET/53060—T1) Fluctuations and transport in fusion plasmas. Final report, October 1, 1981-December 31, 1983.** Gould, R.W. (California Inst. of Tech., Pasadena (USA)). 1983. Contract AT03-76ET53060. 13p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85003613.

This report describes continuing research on fluctuations and anomalous transport in fusion plasmas. The research has an experimental task and a theoretical task. The primary objective is to characterize the properties of the fluctuations observed in tokamaks and to try to develop an understanding of the fluctuation-induced

anomalous transport of particles and heat. The experimental and theoretical activities are closely related. The main thrust of the experimental activity has been to measure and to characterize, in some detail, the main properties of the electric and magnetic fluctuations through various measurements, with emphasis on those properties which appear to relate to transport. The temporal and spatial distribution, spectral characteristics, and cross correlation of various fluctuating quantities are observed. Recently probe arrays (Langmuir probes and photodiodes) have been introduced to permit imaging of the fluctuations. The theoretical activity has emphasized the comparison of experimental results on both turbulence and anomalous transport from various machines with existing theories, including numerical computation and extension of existing theories where necessary. The theoretical activity also provided valuable guidance to the Caltech experimental program.

7928 **(ENEA-RT/FIMA—82-11) BITC - A fortran programme for impurity transport in tokamaks.** Bittoni, E.; Ottaviani, P.L. (ENEA, Rome (Italy)). 1982. 33p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85700104.

A code is described which computes the time evolution of the radial densities of impurities present in a toroidal plasma. Energy losses by radiation are also calculated. Different impurity species, with all their ionization stages, can be taken into account.

7929 **(IPP—1/222) Eddy current losses in the central column of ASDEX upgrade during the plasma discharge and cleaning discharge.** Harmeyer, E. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). Nov 1983. 75p. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE84752315.

The mechanical poloidal field support structure of ASDEX Upgrade contains a column of non-magnetic steel in the centre of the torus arrangement. In this central column eddy current losses occur during the plasma discharge and cleaning discharge. The diffusion problem in the column is solved by analytical methods in this report. The solution is valid for arbitrary temporal development of the exciting current in the OH transformer. The magnetic field obtained is given by a Fourier-Bessel series, the electric field by a DINI series. For an exciting current in the form of a harmonic function or an e-function a closed mathematical expression can be set for the series. The power and energy values and the temperature increase are derived from the electromagnetic field. The impedance of the column and the decrease of the plasma loop voltage caused by the column are calculated.

7930 **(IPP—4/216) RAYIC - a numerical code for the study of ion cyclotron heating of large Tokamak plasmas.** Brambilla, M. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). Feb 1984. 76p. NTIS (US Sales Only), PC A05/MF A01. File Number DE84752323.

The code RAYIC models coupling, propagation and absorption of e.m. waves in large axisymmetric plasmas in the ion cyclotron frequency domain. It can be used both to investigate the waves behaviour, and as a source of the power deposition profiles for use in transport codes. The present user manual, after a brief summary of the physical model, presents the structure of RAYIC, the complete list of input-output variables (calling sequence), and some examples of the output which can be obtained from the code.

7931 **(IPP—6/227) Variational formulation of two-fluid plasmas in Clebsch variables.** Caldas, I.L.; Tasso, H. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). Aug 1983. 10p. NTIS (US Sales Only), PC A02/MF A01. File Number DE84752314.

A variational principle for two-fluid plasmas is obtained by using Clebsch variables. A Hamiltonian formalism is derived and canonical Poisson brackets are defined.

7932 **(IPP—6/229) Anomalous plasma transport as a Wiener process.** Salat, A. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). Aug 1983. 28p. NTIS (US Sales Only), PC A03/MF A01. File Number DE84752313.

A recent theory by MOLVIG et al. on particle transport in turbulent fields with overlapping island structure is critically reviewed. An inconsistency in the derivation of the diffusion coefficient D from the assumption of a Wiener process is pointed out and corrected. In the region $\Delta\Omega x tausub(K) >> 1$ the results if properly interpreted are unchanged. For $\Delta\Omega x tausub(K) << 1$ the results differ ($\Delta\Omega$ = particle velocity/mode correlation length, tausub(K) = "randomization" time). Computer experiments are performed to support the critical arguments.

7933 **(IPP—6/232) Spectrum of a resistive plasma slab.** Lortz, D.; Spies, G.O. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). Dec 1983. 9p. NTIS (US Sales Only), PC A02/MF A01. File Number DE84752320.

The resistive perturbation of the Alfven continuum of incompressible ideal magnetohydrodynamics is derived for an arbitrary static plane slab equilibrium. If the unperturbed continuum does not contain the origin, the perturbed eigenfrequencies fill a system of curves in the stable part of the complex plane which are independent of the resistivity.

7934 **(IPP—6/234) Semi-implicit method for three-dimensional compressible MHD simulation.** Harned, D.S.; Kerner, W. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). Mar 1984. 30p. NTIS (US Sales Only), PC A03/MF A01. File Number DE84752288.

A semi-implicit method for solving the full compressible MHD equations in three dimensions is presented. The method is unconditionally stable with respect to the fast compressional modes. The time step is instead limited by the slower shear Alfven motion. The computing time required for one time step is essentially the same as for explicit methods. Linear stability limits are derived and verified by three-dimensional tests on linear waves in slab geometry.

7935 **(IPP—III/69) Non-Maxwellian ion distributions in the ionization zone of the Tokamak boundary.** Becker, G. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). May 1983. 23p. NTIS (US Sales Only), PC A02/MF A01. File Number DE84752317.

Steady-state ion guiding-centre distributions are computed for the ionization zone of the tokamak boundary by numerically solving the drift-kinetic equation with Coulomb ion-ion and electron-ion collision terms and with sources and sinks due to ionization of and charge exchange with neutrals from the walls. For typical temperatures Tsub(e) = Tsub(i) > or approx. 50 to 100 eV and $n_0/n >$ or approx. $2 \times 10^{-4}$ to $10^{-3}$ one obtains marked deviations from Maxwellian distributions that grow with increasing $n_0/n$ and $Tsub(i)/T_0$. Both ionization and charge exchange can produce large distortions which possibly cause microinstabilities in the boundary. For Tsub(e) approx.= Tsub(i) the contributions of electron-ion collisions to the ion collision term are in the range of a few per cent. The relaxation time to steady-state exceeds the classical ion-ion collision time by about a factor of 4.

7936 **(IPP—III/87) Antennamare, a method of radio-frequency conditioning of fusion plasma.** Lisitano, G. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). Aug 1983. 13p. NTIS (US Sales Only), PC A02/MF A01. File Number DE84752316.

Fusion-relevant conditioning of plasma is to be achieved with high levels of r.f. power launched by means of all-metal, frequency-independent Antennamare structures in the ion cyclotron to lower hybrid frequency range.

7937 **(IPP—III/90) Change of plasma properties prior to high density disruptions in ASDEX.** Niedermeyer, H.; Behringer, K.; Bernhardi, K.; Eberhagen, A.; Fussmann, G.; Gehre, O.; Gernhardt, J.; Haas, G.; Keilhacker, M.; Kissel, S. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). Oct 1983. 28p. NTIS (US Sales Only), PC A03/MF A01. File Number DE84752321.

An anomalous state of the plasma boundary has been found in divertor and limiter discharges near the density limit in the ASDEX tokamak. The plasma parameters are no longer constant on flux surfaces near the boundary. A toroidally symmetric belt shaped region with densities above the central value and very low

temperatures develops at the inner side of the torus. Strongly enhanced radiation from impurity ions in low ionization states is emitted from this plasma region while the mean impurity concentration of the discharge remains unchanged. The drastic change of the parameters in the plasma boundary might be explained by a thermal instability which can appear if the parallel heat conduction time is longer than the local cooling time. This implies that the transverse energy flow from the central plasma to the inner boundary is small. This limitation of heating power in the plasma boundary might be the cause of the density limit of tokamaks.

7938 **(IPP—III/91) First results of time series analysis of MHD fluctuations in the ASDEX tokamak.** Khadra, L. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). Apr 1984. 20p. NTIS (US Sales Only), PC A02/MF A01. File Number DE84752287.

Basic time series analysis techniques are used to investigate MHD fluctuations in ASDEX. In particular, auto- and cross-power spectra are utilized to determine amplitude, frequency, and mode number of the magnetic field fluctuations and soft-X-ray signals. Moreover, time dependent spectra programs are used to follow the frequency evolution of various MHD-model with time. (Some experimental results are presented.)

7939 **(IPP—III/95) Thomson scattering diagnostic in the boundary layer of ASDEX.** Murmann, H.; Huang, M. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). Jul 1983. 25p. NTIS (US Sales Only), PC A02/MF A01. File Number DE84752322.

The divertor experiment ASDEX has been equipped with a Thomson scattering system, designed to measure radially resolved electron temperature and density profiles in the boundary layer between the hot plasma core and the wall. Thus, it is possible to obtain detailed information about plasma edge phenomena as a basis of divertor physics. The measured electron temperature at the magnetic separatrix can be described by the Coppi-Mazzucato scaling law for the electron heat conductivity in ohmically heated plasmas. This is analyzed over a wide range of ASDEX plsama parameters and discharge conditions. During additional heating by neutral injection the Te-profiles show a steepening in the scrape-off area, which can be a consequence of a local decrease in thermal conductivity responsible for the good energy confinement observed for "H"-regime discharges.

7940 (IPPJ—599, pp 17-45) **UCLA work relevant to reacting plasmas.** Dawson, J. (California Univ., Los Angeles (USA)). Jul 1982. NTIS (US Sales Only), PC A99/MF A01. File Number TI85780075. (CONF-8202103—).

From US-Japan working on burning plasma physics and engineering; Nogoya, Japan (10 Feb 1982).

The works at UCLA relevant to reacting plasma are introduced. The items performed at UCLA were as follows, improvement in neutral beam sources, relevant tokamak experiment, heating of a tokamak to fusion temperature, the computational studies of ICRH, the distortion of distribution functions and enhanced reactivity in driven fusion reactors and in ignited plasma, the simulation of instability, and ion sources. The Hot-Wall Microtor is designed to study the plasma-wall interaction and RF heating. As the results of studies, it was able to be said that RF heating was attractive, the Ti coating of antenna system was best for impurity control, the proximity to plasma was essential, the wave studies by laser diagnostics was unavoidable, the theoretical understanding of the behavior of waves in tokamak plasma was not yet secure, the modelling of deconfinement was not yet started, and the observed current rise may be current drive. The conclusion on transport was that no evidence has been found that links magnetic fluctuation to transport, and that radial electric field was dominant. The application of ICRF heating to burning plasma and the R-project, bounded electrostatic particle simulation model and the enhanced reactivity in fusion reactors are discussed.

7941 (IPPJ—599, pp 517-549) **High performance options of a fusion engineering device (FED) with low q and current drive.** Peng, Y.K.M.; Borowski, S.K.; Hively, L.M.; Houlberg, W.A.; Lyon, J.F. (Oak Ridge National Lab., TN (USA)). Jul 1982. NTIS (US Sales Only), PC A99/MF A01. File Number TI85780075. (CONF-8202103—).

From US-Japan working on burning plasma physics and engineering; Nogoya, Japan (10 Feb 1982).

Low q has high potential for permitting disruption-free operation and for improving plasma beta, which in turn enhances plasma performance and/or allows reduced toroidal field and device cost. Non-inductive current drive has high potential for easing the power and voltage required for plasma startup, and for eliminating the cyclic stress due to pulsed field and power load. The results of the present study on the low q operation of a tokamak were compared with the 1981 FED baseline design of medium q. In addition to the assessment of plasma parameters, the FED Systems Analysis Code was utilized to quantify the variation in major device parameters and the relative cost. The results of the study are as follows. The assumption of low q at the plasma edge and the use of tungsten in-board shield will lead to a TFTR-like design regime. Assuming complete non-inductive current drive including startup and steady state burning, the ohmic heating solenoid can be eliminated, accordingly the major radius is reduced. Essentially all benefits of the current drive in the FED will be obtained by assuming non-inductive current drive in an established current channel at low density only by reducing the size of the ohmic heating solenoid. The cost impact of low q, partial non-inductive current drive and tungsten in-board shield was assessed.

7942 (IPPJ—599, pp 135-147) **Thermal instability analysis in a tokamak reactor with density variation.** Sugihara, Masayoshi; Hirayama, Toshio (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment); Hatayama, Akiyoshi. Jul 1982. NTIS (US Sales Only), PC A99/MF A01. File Number TI85780075. (CONF-8202103—).

From US-Japan working on burning plasma physics and engineering; Nogoya, Japan (10 Feb 1982).

Thermal instability analyses in a tokamak reactor are carried out taking account of the particle dynamics e.g. density profile effect, density variation, convective energy loss, particle recycling effect and so on. Growth rates of the instability are calculated for various scaling lows under various operation conditions. Growth rates and the features of unstable mode differ considerably from those without particle dynamics. These results will be essential in realizing control methods of the thermal instability or establishing the sub-ignition scenario.

7943 (IPPJ—599, pp 192-200) **Feedback control of thermal instability with compression-decompression.** Okamoto, Masao; Hirano, Keiichi (Nagoya Univ. (Japan). Inst. of Plasma Physics); Ohnishi, Masami. Jul 1982. NTIS (US Sales Only), PC A99/MF A01. File Number TI85780075. (CONF-8202103—).

From US-Japan working on burning plasma physics and engineering; Nogoya, Japan (10 Feb 1982).

The possible method for the control of burning plasmas in ignited tokamaks is presented. By applying the small scale major radius compression-decompression repeatedly to the plasma with the feedback control, the thermal instability can be suppressed and the plasma stays at an unstable ignition equilibrium point. The variation of major radius $\Delta R$ during the control scales like delt R/R -- - $\Delta n/2n$, where R is the major radius, n is the density and $\Delta n$ is the change in density during control.

7944 (IPPJ—599, pp 550-554) **Current generation by alpha particle. ICRF wave interaction.** Sugihara, R. (Nagoya Univ. (Japan). Inst. of Plasma Physics); Okano, K.; Inoue, N.; Uchida, T. Jul 1982. NTIS (US Sales Only), PC A99/MF A01. File Number TI85780075. (CONF-8202103—).

From US-Japan working on burning plasma physics and engineering; Nogoya, Japan (10 Feb 1982).

7945 (IPPJ—599, pp 555-582) **RF-assisted current start-up in the fusion engineering device (FED).** Borowski, S.K.; Peng, Y.K.M.; Kammash, T. (Oak Ridge National Lab., TN (USA)). Jul 1982. NTIS (US Sales Only), PC A99/MF A01. File Number TI85780075. (CONF-8202103—).

From US-Japan working on burning plasma physics and engineering; Nogoya, Japan (10 Feb 1982).

Auxiliary rf heating of electrons before and during the current rise phase in FED is examined as a means of reducing both the initiation loop voltage and resistive flux expenditure during startup. Prior to current initiation 1 to 2 MW of electron cyclotron resonance heating (ECRH) power at ~90 GHz is used to create a small volume of high conductivity plasma (Tsub(e) asymptoticaly equals 100 eV, nsub(e) asymptoticaly equals $10^{13}$ $cm^3$) near the upper hybrid resonance (UHR) region. This plasma conditioning permits a small radius (asub(o) asymptoticaly equals 0.2 - 0.4 m) current channel to be established with a relatively low initial loop voltage (<=25 V). During the subsequent plasma expansion and current ramp phase, additional rf power is introduced to reduce volt-second consumption due to plasma resistance. A near classical particle and energy transport model has been developed to estimate the efficiency of electron heating in a currentless, toroidal plasma. The model assumes that MHD instabilities are absent due to the presence of an ambipolar sheath potential and a conducting limiter and vacuum vessel which "short-circuits" the vertical charge separation. Preferential electron heating at the UHR leads to the formation of an ambipolar electric field (Esub( a m b)) at the conducting vessel and limiter, which introduces an effective rotational transform via poloidal E vectorsub( a m b) x B vector drift. This drift improves particle confinement and enables the plasma to neutralize itself. The benefits of this effective electrostatic confinement are tempered; however, by the possibility of significant secondary electron emission from the limiters and vessel wall. Reasonable good agreement has been found between our theoretical estimates and the measurements made during ECR preheating experiments on the ISX-B tokamak. This agreement provides some confidence in the preheating power estimates obtained for the FED.

**7946** (IPPJ—599, pp 584-598) **Conceptual design of RFC reactor.** Kumazawa, R.; Adati, K.; Hatori, T.; Ichimura, M.; Obayashi, H.; Okamura, S.; Sato, T.; Watari, T. (Nagoya Univ. (Japan). Inst. of Plasma Physics); Emmert, G.A. Jul 1982. NTIS (US Sales Only), PC A99/MF A01. File Number TI85780075. (CONF-8202103—).

From US-Japan working on burning plasma physics and engineering; Nogoya, Japan (10 Feb 1982).

A parametic analysis and a preliminary conceptual design for RFC reactor (including cusp field) with and without alpha particle heating are described. Steady state operations can be obtained for various RF ponderomotive potential in cases of alpha particle heating.

**7947** (IPPJ—599, pp 80-84) **Introduction to burning plasma physics.** Momota, Hiromu (Nagoya Univ. (Japan). Inst. of Plasma Physics). Jul 1982. NTIS (US Sales Only), PC A99/MF A01. File Number TI85780075. (CONF-8202103—).

From US-Japan working on burning plasma physics and engineering; Nogoya, Japan (10 Feb 1982).

The free energy of fusion-produced charged particles, the critical plasma Q-value for the thermal instability, and the Cherenkov's emission are discussed. The free energy of fusion-produced charged particles is large even in DT burning plasma. The primary role of fusion-produced energetic charged particles is the heating of fuel plasma. If the charged particle heating is large, burning may be thermally unstable. A zero dimensional analysis shows that the critical plasma Q-values for this thermal instability are nearly 5 for DT burning plasma of 14 keV and 1.6 for D-$He^3$ burning plasma of 60 keV. These critical plasma Q-values are small as compared to that required for commercial reactors. Then, some methods of burning-control should be introduced to fusion plasma. Another feature of energetic charged particles may be Cherenkov's emission of various waves in fusion plasma. The relationship between this micro-instability and transport phenomena may be the important problem to be clarified. The fusion-produced energetic charged particles have large Larmor radii, and they may have effects on balooning mode instability.

**7948** (IPPJ—599, pp 201-223) **Theoretical remarks on reactor beta in light of recent ISX-B.** Sigmar, D. (Oak Ridge National Lab., TN (USA)). Jul 1982. NTIS (US Sales Only), PC A99/MF A01. File Number TI85780075. (CONF-8202103—).

From US-Japan working on burning plasma physics and engineering; Nogoya, Japan (10 Feb 1982).

The motivation for this work was to review the premises used until recently to specify the FED design beta-value, to ask what exactly ISX-B has told us about beta/beta-p limits, to briefly discuss the effects of rotation and resistive ballooning modes on confinement, and to give inference for FED and other reactors. In the ISX-B, the confinement time is independent of beta, but depends inversely on beta-p (besides the dependence on NBI power). The soft beta-p limit observed earlier in circular discharge remained valid in shaped discharge. Two major suspects for the apparent saturation of beta-p are plasma relation and resistive ballooning modes. The resistive ballooning modes produce electron and ion losses. Presently, in the ISX-B, fast ion loss is about 10 percent of power balance, but the effect on alpha's in a reactor could be significant. The reactor design at modest beta-p, low q and relatively high toroidal field with vertically elongated plasma cross section is suggested.

**7949** (IPPJ—599, pp 325-354) **Fusion-product diagnostics.** Goldston, R. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Jul 1982. NTIS (US Sales Only), PC A99/MF A01. File Number TI85780075. (CONF-8202103—).

From US-Japan working on burning plasma physics and engineering; Nogoya, Japan (10 Feb 1982).

The TFTR fusion reaction product measurement system is reviewed. The system consists of a neutron activation foil system, an epithermal fission detector system, a neutron spectrometer within a massive collimator and a multichannel neutron collimator. On PLT and PDX, the surface barrier detectors housed in appropriate collimators, with and without foils to reduce X-ray and background, have been used to detect 3 MeV protons from D-D reaction and 14.7 MeV protons from $He^3$-D reaction. The energy spectra of the escaping 3 MeV protons have been used to determine the average energy of reacting D-D particles in ohmically heated and LH heated PLT plasma. The 14 MeV neutron production and the 14.7 MeV proton production have been used to diagnose the burn up fraction of 1 MeV tritium and 0.8 MeV $He^3$ produced from D-D fusion reactors. The problems associated with the detection of escaping alpha particles in large tokamaks are discussed. The Fusion Alpha Confinement Test experiment is reviewed. The effects of a toroidal field probe on suprathermal ions are discussed.

**7950** (IPPJ—599, pp 355-389) **Comment on $\alpha$-particle diagnostics.** Sasao, M. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Jul 1982. NTIS (US Sales Only), PC A99/MF A01. File Number TI85780075. (CONF-8202103—).

From US-Japan working on burning plasma physics and engineering; Nogoya, Japan (10 Feb 1982).

The problems of the alpha-particle diagnostics using neutral atom doping beam were investigated. It might be sufficient to use the beam with the velocity of 0.8 $v(\alpha)$ in order to measure a wide range of the alpha particle velocity spectra. The required beam intensity may be 10 mA, if the neutral He fraction is large enough. The cross sections of neutralization with large neutral He fraction in various gases must be measured. The precise calculation of beam dynamics must be investigated. The test experiment in D-D plasma may be possible and useful. At present, in Japan, the negative ion sources of He are under development. The measurement of the cross sections is in progress.

**7951** (IPPJ—599, pp 115-132) **Ripple loss of alpha particles.** Tani, K.; Takizuka, T.; Azumi, M.; Kishimoto, H. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Jul 1982. NTIS (US Sales Only), PC A99/MF A01. File Number TI85780075. (CONF-8202103—).

From US-Japan working on burning plasma physics and engineering; Nogoya, Japan (10 Feb 1982).

The slowing-down process of alpha particles in a rippled toroidal field is investigated by means of a orbit-following Monte-Carlo code. The power loss fraction of alphas in a reactor-grade tokamak with ~ 1% toroidal field ripple may amount to ~ 15%. Almost all the loss alphas escape from a plasma through ripple-enhanced banana drift and ripple-trapped loss particles are negligibly small.

7952 (IPPJ—599, pp 158-177) **Thermal equilibrium, stability and burn control.** Cohn, D. (Massachusetts Inst. of Tech., Cambridge (USA)). Jul 1982. NTIS (US Sales Only), PC A99/MF A01. File Number TI85780075. (CONF-8202103—).

From US-Japan working on burning plasma physics and engineering; Nogoya, Japan (10 Feb 1982).

A number of aspects of the thermal stability and equilibrium control of ignited tokamak plasma have been investigated. Examined approaches were passive control (the effect of radial motion, the effect of radial motion and small additional transport loss), active control (the compression and decompression of plasma, subignited operation with small amount of variable external heating, and density control), and thermal equilibrium control (additional power loss from impurity radiation and enhanced transport from increased ripple). One-D calculation has been made on thermal instability eigen-modes. It was found that for electron thermal induction loss given by Alcator scaling and for neoclassical ion transport, there was at most one unstable mode with a temperature profile which maintains the temperature profile at thermal equilibrium. The effect of the coupling of temperature fluctuation and the fluctuation in major radius was investigated. Temperature driven radial motion combined with a small amount of ripple transport loss was found to be a very effective mechanism for passive thermal stability control.

7953 (IPPJ—599, pp 178-191) **Effects of magnetic compression on alpha-particle velocity-distribution.** Yamazaki, K.; Okamoto, M. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Jul 1982. NTIS (US Sales Only), PC A99/MF A01. File Number TI85780075. (CONF-8202103—).

From US-Japan working on burning plasma physics and engineering; Nogoya, Japan (10 Feb 1982).

The alpha-driven thermonuclear stability is one of the major subects in the so-called burning plasma physics. The conditions for the isotropic velocity-space stability in a compression tokamak and the possibility of occurrence of the thermonuclear instability were studied. The distribution function of the alpha particles produced by fusion reaction can be approximately given by the Fokker-Planck equation. Then, the velocity distribution function of alpha particles is obtained, and the sufficient condition for the velocity-space stability is deduced. The critical heating rate for the noninversion of velocity distribution is given. In the limiting case of purely adiabatic heating, the critical compression time is found. In order to heat plasma effectively by the compression, a condition should be fulfilled, which suggests that the break-even compression experiment around 10 keV range has some possibility of exciting thermonuclear instability. When the high-temperature (around 20 keV) ignition by means of the compression is required, the alpha particles driven by micro-instability may not be ignored.

7954 (IPPJ—599, pp 224-229) **Ballooning mode instability due to slowed-down ALPHA-particles and associated transport.** Itoh, Sanae (Hiroshima Univ. (Japan)); Itoh, Kimitaka; Tuda, Takashi; Tokuda, Shinji. Jul 1982. NTIS (US Sales Only), PC A99/MF A01. File Number TI85780075. (CONF-8202103—).

From US-Japan working on burning plasma physics and engineering; Nogoya, Japan (10 Feb 1982).

The microscopic stability of tokamak plasma, which contains slowed-down alpha-particles and the anomalous fluxes enhanced by the fluctuation, was studied. The local maxwellian distribution with the density inhomogeneity as the equilibrium distribution of electrons, ions and alpha-particles was chosen. In the zero-beta limit, two branches of eigenmodes, which are electrostatic, were obtained. The electrostatic ballooning mode became unstable by the grad B drift of particles in the toroidal plasma. It should be noted that there was no critical alpha-particle density and no critical beta-value for the onset of the instability in toroidal plasma even in the presence of the magnetic shear. When the beta-value exceeded the critical beta-value of the MHD ballooning mode, the growth rate approached to that of the MHD mode, and the mode structure became very close to that of the MHD mode. The unstable mode in toroidal plasma was the ballooning mode, and was unstable for all plasma parameters. The associated cross-field transport by the ballooning mode is considered. It was found that if the distribution function was assumed to be the birth distribution, the loss rate was very slow and slower than the slowing down time. The effect of alpha-particles on the large scale MHD activity of plasma is discussed.

7955 (IPPJ—599, pp 46-79) **Radial transport of ALPHA-particles in toroidal geometry due to low mode number Alfven waves.** Sigmer, D. (Oak Ridge National Lab., TN (USA)). Jul 1982. NTIS (US Sales Only), PC A99/MF A01. File Number TI85780075. (CONF-8202103—).

From US-Japan working on burning plasma physics and engineering; Nogoya, Japan (10 Feb 1982).

It has been shown that low mode number shear-Alfven waves exist as the radial eigen-modes in a tokamak with shear, both in cylindrical and toroidal equilibrium. For the toroidal equilibria resonant and nonresonant when the sideband coupling from m to m - 2, m - 1, m + 1, m + 2 is included (m is the poroidal Fourier harmonic), the nonresonant modes have large linear growth rank. So far, for the resonant modes, it was found that quasi-linear alpha density broadening was not able to stabilize the spectra. A rough estimate of the strong turbulence (stochastic) alpha-diffusion coefficient showed an anomaly in comparison with the alpha particle-slowing down time.

7956 (IPPJ—599, pp 454-464) **Impurity transport in R tokamak.** Amano, T.; Shimizu, K.; Okamoto, M.; Mizuno, J. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Jul 1982. NTIS (US Sales Only), PC A99/MF A01. File Number TI85780075. (CONF-8202103—).

From US-Japan working on burning plasma physics and engineering; Nogoya, Japan (10 Feb 1982).

A self-consistent modeling of the edge plasma was examined by solving the equations for plasma transport, impurity rate and diffusion. The plasma flow loss to the limiter and the resulting sputtering of the limiter were calculated. The sputtering of the wall by charge exchange fast neutrals was also considered. Sputtered impurity atoms are partly shielded by plasma in the scrape-off region and partly enter into main plasma region. The cooling of the plasma in the scrape off region due to impurity radiation was included to obtain the edge electron temperature. The model was applied to the analysis of the performance of the R-tokamak. Analysis was made for the cases with and without impurity. The time evolution of central electron density, electron temperature, and ion temperature was obtained. The spatial distributions of these quantities were also obtained. The energy balance was estimated. In case of the analysis with impurity, the sputtering of the TiC bumper limiters as well as the sputtering of the TiC coated wall were considered. The neutral impurity deposition was calculated by Monte Carlo method. The results were compared with the results without impurity.

7957 (IPPJ—599, pp 133-134) **Behavior of $\alpha$-particles in an up-down asymmetric ripple.** Naitou, H. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Jul 1982. NTIS (US Sales Only), PC A99/MF A01. File Number TI85780075. (CONF-8202103—).

From US-Japan working on burning plasma physics and engineering; Nogoya, Japan (10 Feb 1982).

7958 (IPPJ—599, pp 85-114) **Effects of toroidal field ripple on suprathermal particles.** Goldston, R. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Jul 1982. NTIS (US Sales Only), PC A99/MF A01. File Number TI85780075. (CONF-8202103—).

From US-Japan working on burning plasma physics and engineering; Nogoya, Japan (10 Feb 1982).

Recent calculation of the effects of toroidal field ripple on suprathermal ions is reviewed. The ripple trapping due to collision is discussed, as well as the ripple-trapping by collisionless process. Collision and collisionless effects move ions within and out of the ripple wells during their subsequent drifting. The banana-drift diffusion of suprathermal ions was also discussed. In the ripple plateau regime of collisionality, the toroidal phase angle of sequential banana bounce points is collisionally decorrelated. In the ripple-collisionless regime, sequential banana bounce points are well correlated. The recent calculation by Linsker and Boozer on the effects of truncating the ripple-transport integral is also discussed. Linsker and Boozer showed that the combined effects resulted in much less

total energy transport than the untruncated integral. In addition, the truncation on the ion energy distribution function resulted in only a modest decrease in the fusion reactivity.

7959 **(IPPJ—603) Observation on stark-shifts of Lyman α lines of low-z ions in laser-produced plasmas.** Hashimoto, S.; Yamaguchi, N. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Jul 1982. 14p. NTIS (US Sales Only), PC A02/MF A01. File Number DE84703200.

The red shifts have been observed for Lyman α lines of Be IV, B V, C VI and N VII at an electron density of 5 x $10^{21}$ $cm^{-3}$. The high density plasma was produced by a 0.1-TW and 100-ps laser irradiation onto a plane target. The shift was measured by comparing the position of highly broadened line center with that of spatially resolved unperturbed one in a single shot photograph. The results are compared with simple theoretical estimations.

7960 **(IPPJ—612) Analysis of target implosion irradiated by proton beam, (1). Beam interaction with target plasma.** Tamba, Moritake; Nagata, Norimasa; Kawata, Shigeo; Niu, Keishiro. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Oct 1982. 54p. NTIS (US Sales Only), PC A04/MF A01. File Number DE84703217.

Numerical simulation and analysis were performed for the implosion of a hollow shell target driven by proton beam. The target consists of three layers of Pb, Al and DT. As the Al layer is heated by proton beam, the layer expands and pushes the DT layer toward the target center. To obtain the optimal velocity of DT implosion, the optimal target size and optimal layer thickness were determined. The target size is determined by, for example, the instability of the implosion or beam focusing on the target surface. The Rayleigh-Taylor instability and the unstable implosion due to the inhomogeneity were investigated. Dissipation, nonlinear effects and density gradient at the boundary were expected to reduce the growth rate of the Rayleigh-Taylor instability during the implosion. In order that the deviation of the boundary surface during the implosion is less than the thickness of fuel, the inhomogeneity of the temperature and the density of the target should be less than ten percent. The amplitude of the boundary surface roughness is required to be less than 4 micrometer.

7961 **(IPPJ—613) Build-up of symmetric space potential in bumpy torus.** Takasugi, K.; Iguchi, H.; Fujiwara, M.; Ikegami, H. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Oct 1982. 15p. NTIS (US Sales Only), PC A02/MF A01. File Number DE84703197.

Radial profiles of the plasma space potential are measured in Nagoya Bumpy Torus (NBT-1) by the use of a rubidium ion beam probe. Asymmetric potential profiles owing to toroidal drift are observed in high pressure operation (C-mode). As the pressure is decreased, toroidal plasma is effectively heated (T-mode), poloidal precessional frequency overcomes the electron collision frequency and the potential profile becomes symmetric inside the hot electron ring.

7962 **(IPPJ—619) Measurement of small-scale density fluctuation in JIPP T-II plasma by millimeter and sub-millimeter wave scattering.** Tetsuka, T.; Nishizawa, A.; Sakai, T.; Kawahata, K.; Mase, A.; Tsukishima, T.; Fujita, J. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Dec 1983. 31p. NTIS (US Sales Only), PC A03/MF A01. File Number DE84703198.

The small-space density fluctuations have been studied by both millimeter (2 mm) and sub-millimeter (337 μm) wave scattering techniques in JIPP T-II plasmas. Experiments were performed in two types of plasma: tokamak and stellarator plasmas. In both plasmas, the density fluctuations are localized in outer region of the plasma column, and show the characteristics of the drift wave mode turbulence. The density fluctuation level is n tilde/nsub(o) asymptotically equals 1-1.5 % around the plasma edge, and this value is inversely proportional to the mean electron density. Further, the dependence of the fluctuation level on the plasma parameters is studied and compared with the scaling law of the energy confinement time of the plasma. The diffusion coefficient estimated from the density fluctuation is about one third of the global diffusion coefficient.

7963 **(IPPJ—620) Effect of trapped electrons on the wave-induced current.** Taguchi, Masayoshi. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Jan 1983. 23p. NTIS (US Sales Only), PC A02/MF A01. File Number DE84703203.

The wave-induced current in a toroidal magnetic field is computed by use of the adjoint drift-kinetic equation for electrons. The inverse aspect ratio of a toroidal device is assumed to be small and the lowest-order terms of this ratio are retained. As the wave-absorption mechanism, the electron cyclotron damping and the electron Landau damping are considered. It is found that the induced current decreases considerably by the effect of the trapped electrons when the phase velocity of a plasma wave is low.

7964 **(IPPJ—621) Generation of Astron-Spherator configuration.** Narihara, Kazumichi; Hasegawa, Mitsuru; Tomita, Yukihiro; Tsuzuki, Tetsuya; Sato, Kuninori; Mohri, Akihiro. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Jan 1983. 24p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700105.

It was experimentally demonstrated that on Astron-Spherator configuration is formed by injecting a pulsed relativistic electron beam in a toroidal device SPAC-VI with external toroidal and vertical magnetic fields. A plasma is confined in the extended magnetic region produced by a slender core of current carrying energetic electrons. This configuration continued for 40 ms without fatal instabilities.

7965 **(IPPJ—622) Behaviour of population in a plasma interacting with an atomic gas.** Furukane, Utaro; Oda, Toshiatsu. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Jan 1983. 35p. NTIS (US Sales Only), PC A03/MF A01. File Number DE84703201.

The processes leading to the population inversion are investigated in a recombining hydrogen plasma which is interacting with a cool and dense neutral hydrogen gas by using the rate equations on the basis of the CR model and the energy equation for electrons ions and neutral particles. The quasi-steady state approximation are used only for the levels higher than a certain level which is not the first excited level. The calculations have shown that the quasi-steady state cannot be realized while intense energy-flows due to the collisional processes exist between different kinds of the particles such as the electrons and the ions in the plasma and the population inversion is realized only in the quasi-steady state following the transient phase. The effects of the initial conditions of the hydrogen plasma and the introduced neutral hydrogen gas on the overpopulation density are also discussed.

7966 **(IPPJ—624) Plasma behaviors in the open field region of reversed-field theta-pinch.** Aso, Yoshiyuki; Hirano, Keiichi. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Mar 1983. 11p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700110.

A characteristic behavior of the plasma in an open field region of reversed field theta pinch has been studied with the guide field (GF) which extends the field line along the axial direction. The experimental result suggests that the rotaional instability may be induced in FRC after the plasma touches the wall at the ends of the open field.

7967 **(IPPJ—626) Experimental studies on energy transport in a reversed field theta pinch.** Aso, Y.; Himeno, S.; Hirano, K. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Mar 1983. 39p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85700106.

The transport of energy and particles from a field reversed configuration (FRC) produced by a theta-pinch has been experimentally studied under the following typical plasma parameters in the quasi-static phase; Tsub(i) -- 300 eV, Tsub(e) -- 100 eV, n-barsub(e) -- 5 x $10^{15}$ $cm^{-3}$, $<\beta>$ -- 1, <Zsub(eff)> -- 3 and the separatrix radius rsub(s) -- 1.8 cm. Energy transport through various processes has been evaluated, as is consistent with the observed volume averaged quantities which are changing in time with a quasi-static manner. As a result it has been found that the dominant energy loss mechanism is particles loss, which accounts for more than 50 % of the power flow out of the FRC. The second impor-

tant process is the electron thermal conduction loss which is estimated to be roughly 30 % of the total loss if impurity radiation losses other than by carbon and oxygen are not important. In contrast, the ion thermal conduction loss is observed to be so small as to be hidden by the experimental errors. Radiation loss has been estimated to play a minor role if the observed <Zsub(eff)> can be ascribed to contaminations of only carbon and oxygen. The inferred energy confinement time tau sub(E) is 7 μs, which compares with the observed particle confinement time tausub(p) of 17 μs. The data indicates that tausub(p) is consistent with classical diffusion theories.

7968 **(IPPJ—628) Simple method of sheet plasma production in lower pressure.** Uramoto, Joshin. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Mar 1983. 12p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700107.

A method of sheet plasma production in a lower pressure ( ~ $2 \times 10^{-4}$ Torr of $H_2$) is found: A primary sheet plasma produced between a discharge anode and cathode by the previous method due to two rectangular permanent magnets, diffuses into the low pressure region through a rectangular slit of the anode while electrons are reflected along magnetic field by a floating metal plate at the end of the plasma.

7969 **(IPPJ—629) Comparison of lower hybrid ion heating in tokamak and stellarator plasmas in JIPP T-II.** Ohkubo, K.; Kawahata, K.; Kawasumi, Y.; Matsuoka, K.; Noda, N.; Sakurai, K.; Tanahashi, S.; Matsuura, K.; Fujita, J. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Apr 1983. 40p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85700108.

Experimental studies of lower hybrid ion heating in the tokamak and stellarator plasmas have been carried out in the JIPP T-II torus. In both operations of the tokamak and the stellarator, ion heating efficiency of n-barsub(e)ΔTsub(i)/Psub(net) = $1.2 \times 10^{13}$ $eV.kW^{-1}.cm^{-3}$ is observed at a power level of 160-180 kW. The ion absorption efficiency of RF power in the stellarator is two-thirds as large as that in the tokamak. It is confirmed that the perpendicular energetic-ion tails are produced near the plasma center and suffered from the pitch-angle scattering to the parallel direction, and at the same time, energetic ions escape out of the plasma due to nablaB-drift.

7970 **(IPPJ—630) Soft-x-ray imaging study on disruptions in the JIPP T-II tokamak.** Tsuji, Shunji. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Apr 1983. 189p. NTIS (US Sales Only), PC A09/MF A01. File Number DE85700111.

A multi-channel soft X-ray imaging system (29 channels for viewing the plasma cross section, 3 channels for identifying poloidal and toroidal mode numbers, m and n, respectively) was installed on the JIPP T-II device to investigate external disruptions. A high-performance digital data acquisition system (12-bit resolution, 40 channels, 100 kHz/channel) was newly developed for data processing. A weak m=1/n=1 mode which is locked with an m=2/n=1 mode is observed preceding an external disruption. Once the disruption occured, the m=2/n=1 mode is converted into a strong m=1/n=1 mode. The internal thermal energy is swept out accompanied by vertically asymmetric collapse of soft X-ray profile due to the m=1/n=1 mode. A localized flash on the limiter is always observed due to a major disruption (a hard external disruption). These phenomena can be explained by the theory of asymmetric reconnections due to the interaction of the m=2/n=1 and m=1/n=1 modes proposed by B.B. Kadomtsev. If the amplitude of the m=2/n=1 mode becomes sufficiently large, the resulting islands begin to come closer and to produce a m=1/n=1 shift at the center. And eventually asymmetric reconnections will occur at the place where the shifted inner region due to the m=1/n=1 mode touches the X-point of the separatrix of the m=2/n=1 magnetic island. Since the modes with different helicities can not exist at the same place, the m=2/n=1 islands approach with each other and merge into an m=1/n=1 island. During this process the internal thermal energy is expelled in the same way as the usual internal disruption. If the reconnections extend to the plasma boundary, they may lead to a major diruption. Although the overlapping of the m=2/n=1 and m=3/n=2 islands is experimentally observed, the resulting ergodization of the magnetic surfaces only flatten the soft X-ray profile in the region between q = 2 and q = 3/2 surfaces.

7971 **(IPPJ—631) Dissipative effects on stable RFP configuration.** Nakajima, N.; Nomura, Y.; Momota, H. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Apr 1983. 31p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85700109.

Evolutions of RFP equilibria due to dissipative effects are studied theoretically. It is shown that the existence of stable RFP equilibria satisfying ideal and nonideal MHD stability criteria requires adequate hollow temperature profiles. If no profile control is applied to these RFP equilibria, the sufficient condition of stability for m = 1 modes is first violated due to the disappearance of the toroidal current reversal near the surface within a short time.

7972 **(IPPJ—633) Equilibria of field-reversed configuration with subsidiary coils.** Kako, Masashi; Ishimura, Tsutomu; Amano, Tsuneo. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Apr 1983. 34p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85700112.

Two-dimensional equilibria of field-reversed configuration with subsidiary coils are computed by integrating the ideal magnetohydrodynamic equilibrium equation. The mirror coils assist to compress the plasma appreciably in the axial direction and also help sustain a literal 'compact torus', which is just smaller than inner dimensions of the main coil. The cusp coils enlarge the plasma and consequently make the gradient of plasma density relaxed in the radial direction.

7973 **(IPPJ—634) High-$\beta$ ballooning-mode structures in axisymmetric mirrors.** Hatakeyama, R.; Sato, N.; Inutake, M. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Jun 1983. 27p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85700113.

A low-frequency magnetic mode is observed to grow in a line-tied axisymmetric mirror with increasing plasma $\beta$ up to $\beta$sub(c) predicted by ideal MHD ballooning-mode theory. The instability is excited like a standing wave in a region of unfavorable curvature and steep redial pressure-gradient, traveling outward from the mirror well with a velocity less than the Alfven but higher than the sound velocity. It propagates azimuthally around the ion-diamagnetic drift frequency with m=2 for $\beta <= \beta$sub(c), while appearing to propagate in the electron-diamagnetic direction for $\beta < \beta$sub(c). Results are consistent with ballooning-mode structures.

7974 **(IPPJ—635) Dissipative trapped ion instability in PLT and INTOR.** Wakamatsu, A.; Shimizu, K.; Ogasawara, M. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Jun 1983. 20p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700114.

The generation conditions of the dissipative trapped ion instability (DTII) are investigated for the parameters of PLT and INTOR. The finite banana width effect is taken into account in the dispersion relation. The conditions are greatly influenced by the impurities. Though the plasmas are well in the banana regime in bothe PLT and INTOR, DTII is not excited for Zsub(eff) = 3.5, and excited but it has negative growth rate for Zsub(eff) = 1.5, where Zsub(eff) is the effective charge number. Only for the pure case (Zsub(eff) = 1.0), the growth rate has small positive value in INTOR.

7975 **(IPPJ—638) Multipole stabilization of rotational instability in a theta pinch, 1.** Ishimura, Tsutomu. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Jul 1983. 46p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85700115.

Theoretical analysis based on MHD approximation is carried out on the effect of multipole field to suppress the rotational instabilities excited in a high $\beta$ plasma column. The multipole field is assumed not to penetrate into the plasma column but to exert the magnetic pressure on its boundary surface so as to suppress the distortion of the plasma column. The analytical theory taking into ac-

count only the effects of the fundamental wave gives the stability criterion for the n = 2 mode as Bsub(s) >= Bsub(s,c) = 1/2(m-1)sup(-1/2)rsub(s)$^{+}$ $\Omega^{+}$ ($\mu_0$rho$_\infty$)sup(1/2), where rsub(s), rho$_\infty$ and $\Omega$ are the radius, mass density and rotational angular velocity of the plasma column, respectively, 2m the order of the multipole field, Bsub(s) the field strength at radius rsub(s) in vacuum state, and $\mu_0$ the permeability of vacuum. The numerical calculation including the effects of the waves parasitic to the fundamental wave supports the stability criterion for hexapole (m = 3) and octopole (m = 4) fields. For quadrupole (m = 2) field, it shows that the stable range of Bsub(s) is limited between 0.841 Bsub(s,c) and 0.856 Bsub(s,c) where Bsub(s,c) is the analytical threshold for m = 2.

7976 **(JAERI-M—83-085) Positional instability analysis of tokamak plasmas by ERATO.** Kumagai, Michikazu; Tsunematsu, Toshihide; Tokuda, Shinji; Takeda, Tatsuoki. (Japan Atomic Energy Research Inst., Tokyo). Jun 1983. 30p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. File Number DE84703202.

The stability of axisymmetric modes of a tokamak plasma(positional instabilities) is analyzed for the Solov'ev equilibrium by using the linear ideal MHD code ERATO-J. The dependence of the stability on various parameters, i.e., the ellipticity and triangularity of the plasma cross-section, the aspect ratio, the safety factor at the magnetic axis, and the distance between the plasma and a conducting shell is investigated. Comparison of the results with those by the rigid model shows that the stability condition derived from the rigid model in terms of the decay index(n-index) of the external equilibrating field is a good approximation for the plasma with small triangular deformation. Also the results are compared with those of the rigid displacement model and applicability of the various models on the positional instability analyses is discussed.

7977 **(JAERI-M—83-141) Active beam scattering apparatus and its application to JFT-2 tokamak.** Takeuchi, Hiroshi; Matsuda, Toshiaki; Nishitani, Takeo; Shiho, Makoto; Maeda, Hikosuke; Konagai, Chikara; Kimura, Hironobu. (Japan Atomic Energy Research Inst., Tokyo). Sep 1983. 18p. NTIS (US Sales Only), PC A02/MF A01. File Number DE84703199.

The capability to assess the ion temperatures using a neutral beam scattering system is investigated on the JFT-2 tokamak. The neutral beam scattering system consists of a 15 KeV neutral hydrogen atom beam and a momentum analyser with silicon surface barrier detectors. The energy analysis of scattered particles on the scattering angle of 4° gives the estimation of ion temperatures, which agree well with the one deduced from passive charge-exchange neutral measurements. The influence of impurity ions to the scattering spectrum is not observed and the results of gas scattering experiments suggests that this phenomenon occurs because of the ionization of neutral beam due to the collisions with impurity ions.

7978 **(Juel—1898) ECE diagnostic system on TEXTOR.** Waidmann, G. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Plasmaphysik). Feb 1984. 27p. NTIS (US Sales Only), PC A03/MF A01. File Number DE84752286.

A heterodyne millimeter wave radiometer was built to record simultaneously the first ordinary and second extraordinary wave of ECE emitted from the same point in the plasma. The optical depth of the TEXTOR plasma was calculated for typical TEXTOR parameters. The accessibility of ECE-radiation was considered. First experimental results from TEXTOR are presented. The electron temperature on axis of the TEXTOR plasma is routinely monitored from ECE intensity measurements. An instantaneous half electron temperature profile and its development in time are shown. Internal plasma disruptions are visualized by a sawtooth modulation of the ECE intensity. Also MHD-activity in the plasma is reflected in the ECE.

7979 **(Juel—1909) System with high resolution for analogue recording and digital processing of measured values in fusion research.** Korten, M.; Lochter, M.; Lange, W.R. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Plasmaphysik). Apr 1984. 46p. (In German). (CONF-8405233—1). NTIS (US Sales Only), PC A03/MF A01. File Number DE84752302.

From 1. European telemetry conference (ETC'84) and 7. national conference and exhibition of the Arbeitskreis Telemetria e.V.; Boeblingen, F.R. Germany (21 May 1984).

Complexity and amount of physical and technical data to be recorded during TEXTOR operation require support of a powerful computer system for data acquisition, analysis, storage and display. Most of the physical quantities are recorded digitally and stored online on the computer's mass storage devices for further processing. In addition to the scientific objectives, monitoring and maintenance, interface problems and machine faults rise complex measurement problems for the manyfold technical components of the device. Here, a high temporal resolution of the order 100 kHz sampling rate is required over a period of 4 sec for several parallel signal channels, which would cause a large amount of data to be stored and processed using pure digital recording methods. However, it is in the nature of the problem that only small but previously unknown parts of the information are of relevance. An inexpensive way of combining a high resolution long range recording with moderate overhead for digital processing and storage was found by using a hybrid system of an analogue tape recorder combined with a computerized digital acquisition and processing system. This paper describes the complete recording and processing system consisting of the tape recorder, the time code generator, the tape search control unit and the digital data acquisition and computer system. We describe the operational experience obtained so far and display typical examples.

7980 **(ORNL/FEDC—84/1) Plasma performance of TFCX and JET with sawtoothing.** Hively, L.M.; Mikkelsen, D.R. (Oak Ridge National Lab., TN (USA)). Nov 1984. Contract AC05-84OR21400. 28p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85004386.

The plasma performance is assessed for two tokamak reactor experiments, the Tokamak Fusion Core Experiment (TFCX) and the Joint European Torus (JET). Both machines appear ignitable for a reasonable range of transport assumptions.

7981 **(ORNL/TM—9219) Electrostatic confinement in a bumpy torus.** El Nadi, A.M. (Oak Ridge National Lab., TN (USA)). Nov 1984. Contract AC05-84OR21400. 24p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85003794.

In a closed-field-line device such as a bumpy torus, the combined E x B and del B drifts lead to charge separation that is balanced by the ion polarization drift. In this work, we determine self-consistent potential and density profiles and the condition for electric island formation.

7982 **(ORNL/TM—9306) Magnetic fluctuations, field reversal maintenance, and anomalous thermal transport in the reversed field pinch.** Diamond, P.H.; An, Z.G.; Rosenbluth, M.N.; Carreras, B.A.; Hender, T.C.; Holmes, J.A. (Oak Ridge National Lab., TN (USA)). Nov 1984. Contract AC05-84OR21400. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003804.

A theory of magnetic fluctuations, field reversal maintenance (dynamo activity), and anomalous thermal transport in the Reversed Field Pinch is proposed. Nonlinear generation of and coupling to m $\geq$ 2 modes is advanced as an m = 1 tearing mode saturation mechanism. The mechanism by which nonlinear m = 1 tearing modes sustain the toroidal magnetic field is elucidated. The predicted fluctuation levels and scalings are consistent with those required for maintaining the B/sub z/ configuration. Heat transport is estimated using stochastic magnetic field diffusion arguments.

**7983 (ORNL/TM—9351) Theory and calculation of finite beta drift wave turbulence.** Beasley, C.O. Jr.; Molvig, K.; Freidberg, J.P.; van Rij, W.I. (Oak Ridge National Lab., TN (USA); Massachusetts Inst. of Tech., Cambridge (USA)). Nov 1984. Contract AC05-84OR21400. 43p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85004385.

Using numerical techniques, we calculate eigenmodes of the nonlinear universal mode with finite beta in order to determine the scaling of the saturation level of the instability with beta. We use two different renormalizations in the calculations and find that using the appropriate renormalization, we are able to recover Alcator density scaling, as originally found in analytic work by Molvig and Hirshman. We also find that the universal mode should be stable in ohmically heated tokamaks above a critical beta on the order of 0.02.

**7984 (PPPL—2154) Hamiltonian representation of divergence-free fields.** Boozer, A.H. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Nov 1984. Contract AC02-76CH03073. 13p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85004400.

Globally divergence-free fields, such as the magnetic field and the vorticity, can be described by a two degree of freedom Hamiltonian. The Hamiltonian function provides a complete topological description of the field lines. The formulation also separates the dissipative and inertial time scale evolution of the magnetic and the vorticity fields.

**7985 (PPPL—2156) Charge-exchange measurements of beam ion thermalization in MHD-quiescent plasmas in the Poloidal Divertor Experiment.** Kaita, R.; Goldston, R.J.; Beiersdorfer, P.; Herndon, D.L.; Kaye, S.M.; Kugel, H.W.; McCann, R.T.; McCune, D.C.; Meyerhofer, D.D.; Towner, H.H. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Oct 1984. Contract AC02-76CH03073. 60p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85004167.

The horizontally scanning, multiangle charge-exchange analyzer on the Poloidal Divertor Experiment (PDX) was used to study the beam ion slowing-down process with high-power perpendicular injection. Measurements were made over a wide range in toroidal field (8 kG < B(T) < 22 kG), plasma current (200 kA < I(p) < 500 kA), and beam power (1 MW < P/sub B/ < 7 MW). In MHD-quiescent plasmas, good agreement is found between the measured slowing-down spectra and theoretical predictions as a function of both angle and energy. Classes of prompt orbit losses are observed with both co- and counter-injection which have been understood and applied to plasma diagnostics. The effects of MHD activity on fast ion thermalization will be the subject of a companion paper.

**7986 (PPPL—2162) New method for computing ideal MHD normal modes in axisymmetric toroidal geometry.** Wysocki, F.; Grimm, R.C. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Nov 1984. Contract AC02-76CH03073. 39p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85004402.

Analytic elimination of the two magnetic surface components of the displacement vector permits the normal mode ideal MHD equations to be reduced to a scalar form. A Galerkin procedure, similar to that used in the PEST codes, is implemented to determine the normal modes computationally. The method retains the efficient stability capabilities of the PEST 2 energy principle code, while allowing computation of the normal mode frequencies and eigenfunctions, if desired. The procedure is illustrated by comparison with earlier various of PEST and by application to tilting modes in spheromaks, and to stable discrete Alfven waves in tokamak geometry.

**7987 (PPPL—2165) Studies of energetic ion confinement during fishbone events in PDX.** Strachan, J.D.; Grek, B.; Heidbrink, W.; Johnson, D.; Kaye, S.; Kugel, H.; LeBlanc, B.; McGuire, K. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Nov 1984. Contract AC02-76CH03073. 69p. NTIS, PC A04/MF AO1; GPO Dep. File Number DE85004399.

The 2.5-MeV neutron emission from the beam-target d(d,n)$^3$He fusion reaction has been examined for all PDX deuterium plasmas which were heated by deuterium neutral beams. The magnitude of the emission was found to scale classically and increase with T/sub e//sup 3/2/ as expected when electron drag is the primary energy degradation mechanism. The time evolution of the neutron emission through fishbone events was measured and used to determine the confinement properties of the energetic beam ions. Many of the experimental results are predicted by the Mode Particle Pumping theory.

**7988 (PPPL—2167) Electromagnetic two-dimensional analysis of trapped-ion eigenmodes.** Kim, D.; Rewoldt, G. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Nov 1984. Contract AC02-76CH03073. 35p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85004403.

A two-dimensional electromagnetic analysis of the trapped-ion instability for the tokamak case with $\beta$ not equal to 0 has been made, based on previous work in the electrostatic limit. The quasineutrality condition and the component of Ampere's law along the equilibrium magnetic field are solved for the perturbed electrostatic potential and the component of the perturbed vector potential along the equilibrium magnetic field. The general integro-differential equations are converted into a matrix eigenvalue-eigenfunction problem by expanding in cubic B-spline finite elements in the minor radius and in Fourier harmonics in the poloidal angle. A model MHD equilibrium with circular, concentric magnetic surfaces and large aspect ratio is used which is consistent with our assemption that B << 1. The effect on the trapped-ion mode of including these electromagnetic extensions to the calculation is considered, and the temperature (and $\beta$) scaling of the mode frequency is shown and discussed.

**7989 (PPPL—2172) Charge-exchange recombination spectroscopy measurements of ion temperature and plasma rotation in PBX.** Jaehnig, K.P.; Fonck, R.J.; Ida, K.; Powell, E.T. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Nov 1984. Contract AC02-76CH03073. 17p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85003709.

The primary diagnostic on PBX for ion temperature measurements is charge-exchange recombination spectroscopy of low Z ions, wherein fast neutrals from the heating neutral beams excite spectral lines from highly excited states ($n \geq 4$) of hydrogenic 0, C, and He via charge-exchange collisions with the respective fully stripped ions. Since the neutral beams on PBX provide relatively low velocity neutrals (i.e., $D^0$ beams at 44 keV), the best signals are obtained using the near-uv lines of $0^{7+}$ (e.g., n = 8-7, 2976 A). Off-line analysis of the Doppler broadened and shifted line profiles includes non-linear least squares fitting to a model line profile, while a simplified on-line fast analysis code permits between-shot data analysis.

**7990 (PPPL—2173) TFTR horizontal high-resolution Bragg x-ray spectrometer.** Hill, K.W.; Bitter, M.; Tavernier, M.; Diesso, M.; von Goeler, S.; Johnson, G.; Johnson, L.C.; Sauthoff, N.R.; Schechtman, N.; Sesnic, S.; Tenney, F.; Young, K.M. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Nov 1984. Contract AC02-76CH03073. 22p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85004397.

A bent quartz crystal spectrometer of the Johann type with a spectral resolution of $\lambda/\Delta\lambda$ = 10,000 to 25,000 is used on TFTR to determine central plasma parameters from the spectra of heliumlike and lithiumlike metal impurity ions (Ti, Cr, Fe, and Ni). The spectra are observed along a central radial chord and are recorded by a position sensitive multiwire proportional counter with a spatial resolution of 250. Standard delay-line time-difference readout is employed. The data are histogrammed and stored in 64k of memory providing 128 time groups of 512-channel spectra. The central ion temperature and the toroidal plasma rotation are inferred from the Doppler broadening and Doppler shift of the K lines. The central electron temperature, the distribution of ionization states, and dielectronic recombination rates are obtained from satellite-to-resonance line ratios. The performance of the spectrometer is demonstrated by measurements of the Ti XXI K radiation.

**7991 (UCRL—91120) Plasma modeling of MFTF-B and the sensitivity to vacuum conditions.** Porter, G.D.; Rensink, M. (Lawrence Livermore National Lab., CA (USA)). 12 Sep 1984. Contract W-7405-ENG-48. 14p. (CONF-841218—9). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003615.

From 31. national vacuum symposium; Reno, NV, USA (3 Dec 1984).

The Mirror Fusion Test Facility (MFTF-B) is a large tandem mirror device currently under construction at Lawrence Livermore National Laboratory. The completed facility will consist of a large variety of components. Specifically, the vacuum vessel that houses the magnetic coils is basically a cylindrical vessel 60 m long and 11 m in diameter. The magnetics system consists of some 28 superconducting coils, each of which is located within the main vacuum vessel. Twenty of these coils are relatively simple solenoidal coils, but the remaining eight are of a more complicated design to provide an octupole component to certain regions of the magnetic field. The vacuum system is composed of a rough vacuum chain, used to evacuate the vessel from atmospheric pressure, and a high vacuum system, used to maintain good vacuum conditions during a plasma shot. High vacuum pumping is accomplished primarily by cryogenic panels cooled to 4.5°K. The MFTF-B coil set is shown together with typical axial profiles of magnetic field (a), electrostatic potential (b), and plasma density (c). The plasma is divided into nine regions axially, as labelled on the coil set in Figure 1. The central cell, which is completely azimuthally symmetric, contains a large volume plasma that is confined by a combination of the magnetic fields and the electrostatic potentials in the yin-yang cell.

**7992 Magnetic curvature-drift instability.** Finn, J.M.; Drake, J.F. (Laboratory for Plasma and Fusion Energy Studies, University of Maryland, College Park, Maryland 20742). *Physical Review Letters;* **53**: No. 24, 2308-2311(10 Dec 1984).

A new fluid instability has been discovered which arises from the coupling of the drift-tearing mode at the diamagnetic frequency with a mode with a velocity just below the curvature drift velocity. This mode, which can also be destabilized by cross field transport, is unstable over a wide range of conditions and mode numbers for reversed-field pinches or spheromaks.

**7993 Parametric instabilities in the fast-wave heating of tokamaks.** Tripathi, V.K. (GA Technologies, Inc., San Diego, California 92138). *Physics of Fluids;* **27**: No. 12, 2868-2873(Dec 1984). Contract AT03-76ET51011.

A high-power whistler wave launched into a tokomak is susceptible to resonant decay into ion-cyclotron and lower-hybrid waves when the lower-hybrid resonance layer $\omega/\text{sub lh/} = \omega_0$ exists in the outer region of the plasma $x^2/a^2 >$ or $\approx 0.6$, where $\omega_0$ is the frequency of the whistler, $\omega/\text{sub lh/}$ is the lower-hybrid frequency, x is the distance away from the center of the plasma, and a is the minor radius. For Princeton Large Torus parameters, this requires a line average density n> or $\approx 6 \times 10^{13}$ cm$^{-3}$ when the whistler frequency $\omega_0 \approx 800$ MHz and the threshold pump power for the onset of the instability is 100 kW. The threshold power is determined by the convection losses and it increases nonlinearly with the temperature and very rapidly with decreasing density. The parametric instability would tend to deposit the momentum and energy of the pump wave in the outer region of the plasma.

**7994 Turbulent structure in the edge plasma of the TEXT tokamak.** Ritz, C.P.; Bengtson, R.D.; Levinson, S.J.; Powers, E.J. (The University of Texas at Austin, Austin, Texas 78712). *Physics of Fluids;* **27**: No. 12, 2956-2959(Dec 1984). Contract AC05-78ET53043.

A reversal has been observed in the mean phase velocity of the turbulent fluctuations in the edge plasma of the TEXT tokamak. The observations can be described by a model in which the wave velocity in the lab frame is dominated by a nonuniform E/sub r/ x B velocity and a gradient driven drift. The measurements also exhibit a localized instability which occurs in the region of maximum velocity shear.

**7995 Stabilization of the spheromak tilt instability.** Litwin, C.; Sudan, R.N.; Turnbull, A.D. (Laboratory of Plasma Studies, Cornell University, Ithaca, New York 14853). *Physics of Fluids;* **27**: No. 12, 2791-2793(Dec 1984).

A stability criterion for the tilt mode of a spheromak-ion ring hybrid configuration has been developed for the case where the ring current is small compared to the spheromak azimuthal current. It is shown that the stability is related to the distortion of the spheromak separatrix.

**7996 Propagation and absorption of electromagnetic waves in fully relativistic plasmas.** Batchelor, D.B.; Goldfinger, R.C.; Weitzner, H. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physics of Fluids;* **27**: No. 12, 2835-2846(Dec 1984). Contract W-7405-ENG-26.

The propagation and absorption of electromagnetic waves in a relativistic Maxwellian plasma are investigated by solving the uniform plasma dispersion relation. Both the Hermitian and the anti-Hermitian parts of the plasma conductivity tensor $\sigma$ are calculated relativistically. The Bessel functions occurring in $\sigma$ are not expanded, and many cyclotron harmonic terms are included at high temperatures. The dispersion relation is solved numerically for perpendicular propagation, k/sub parallel/ = 0, where the relativistic effects are maximum and are not masked by Doppler broadening, which has been more thoroughly investigated. It is found that relativistic broadening has a substantial effect on wave dispersion, shifting the extraordinary mode right-hand cutoff and the upper-hybrid resonance to higher magnetic field with increasing temperature. Above a critical temperature, the cutoff disappears entirely. There is a broad range of temperatures, 20 keV< or =T/sub e/ < or =500 keV, for which the wavenumber k/sub perpendicular/ differs significantly from both the cold-plasma value and the vacuum value. This has important implications for ray tracing in relativistic plasmas. Wave damping rates are calculated and compared to results from a previous formulation using the Poynting theorem, in which only the Hermitian part of $\sigma$ is calculated relativistically.

**7997 Image enhancement tools for tracing fringe patterns in holographic interferograms acquired during laser fusion experiments.** Vavra, P.C.; Busch, G.E.; Shepard, C.L. (KMS Fusion Inc., Ann Arbor, MI). *Proceedings of the Society of Photo-Optical Instrumentation Engineers;* **432**: 2-5(1983). Contract AC08-82DP40152.

Pulsed holographic interferometry is essentially the only direct method for determining electron density profiles in inertial fusion plasmas. Consequently, it is a very important diagnostic tool in laser fusion experimentation. The tracing of fringe patterns in the reconstructed holograms is required to determine their precise number and location for subsequent Abel inversion. This is a very labor-intensive task, for which computer assistance has long been sought. In the KMS Fusion multiframe optical probing system, a sequence of four time resolved image frames is produced at rates equivalent to over 5 billion/sec. The increased number of images thus generated has spurred the development of improved methods for handling data. A plan has evolved for providing scientists with interactive adaptive image enhancement tools to assist in locating the fringes. The feasibility of applying digital techniques to aid in the analysis of holographic interferograms has been demonstrated by others. However, only limited success has been achieved in tracing highly dense fringes in the presence of noise. Traditional noise reduction methods tend to fail in the case of high density fringes, where the spatial frequency of the noise is close to that of the pattern to be discerned. Other problems are introduced by uneven lighting conditions, competing fringe patterns (due to aberrations in optical components or other attenuators in the optical path), and bonafide discontinuities in the fringes. Newly developed digital enhancement tools apply tailorable neighborhood operators to individual pixels as directed by a cursor that may be manipulated via jobstick or keyboard control. Operations may be performed on a sectional blow-up while viewing both the full image and the enlarged section. In this manner, global information can be utilized to aid in the local enhancement operations, and vice versa.

## 7002 Fusion Power Plant Technology

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7998 **(CONF-8410187—1) INTOR critical issue D: maintainability. Tritium containment and personnel access vs remote maintenance, Chapter VI of the US INTOR report for Phase Two A, Part 2.** Spampinato, P.T.; Finn, P.A.; Gohar, Y.; Yang, S.T.; Stasko, R.R.; Morrison, C.; Russell, S.; Shaw, G.; Bussell, G.T.; Watts, R. (Oak Ridge National Lab., TN (USA); Grumman Aerospace Corp., Bethpage, NY (USA); Argonne National Lab., IL (USA); Ontario Hydro, Toronto (Canada)). 1984. Contract AC05-84OR21400. 163p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE85002484.

From INTOR workshop; Vienna, Austria (25 Oct 1984).

The purpose of this study is to compare the benefits and costs associated with personnel access mmaintenance procedures compared to those of all-remote maintenance procedures. The INTOR Phase Two A, Part I configuration was used to make this comparison. For both approaches, capital and operating costs were considered to first order, maintenance equipment requirements were investigated, maintenance requirements common to both approaches and unique to each were identified, tritium handling requirements were outlined, and maintenance scenarios and device downtime were developed for both. In addition, estimates of person-rem exposure were made for the personnel access approach.

7999 **(DOE/ET/51013—136) Cost-performance evaluation of the use of a 10 T central solenoid in INTOR.** Schultz, J.H. (Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center). 9 Nov 1984. Contract AC02-78ET51013. 15p. (PFC/RR—84-16). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004406.

The change from a nominal 8 T to a nominal 10 T system has a second-order effect on both the volt-second capability of the poloidal field system and the costs associated with it. By contrast, there is a first-order increase in the burn time, under the reference scenario. This has to be tempered in two directions. On the one hand, the value of the machine mission may be a slow function of burn time (i.e., doubling the burn time does not double the value of the experiment). On the other hand, the risk associated with losing all of the burn time due to a relatively small change in the plasma impurity level must be substantially reduced with the buffer of an additional 17 V-s. Since the effect on the overall machine cost must be third-order, the 10 T option appears to be favored.

8000 **(GA-A—17389) Low activation fusion design studies. Annual report for FY 1983.** Hopkins, G.; Cheng, E.T.; Levine, H.E.; Maya, I.; Schultz, K.R. (GA Technologies, Inc., San Diego, CA (USA)). Oct 1984. Contract AT03-76ET51011. 167p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE85004394.

Low activation in fusion is achieved by substitution of low activation materials, typically aluminum alloys, graphite, and SiC, for the more conventional stainless steel materials used in construction of a fusion power reactor. The nuclear design of a very low activation fusion system was completed. A tritium breeding ratio of 1.15 tritons per D-T neutron was achieved. A scoping study to assess the feasibility of a SiC/$Li_{17}Pb_{83}$ blanket for a mirror reactor was performed. The blanket consists of 5 cm diameter SiC tubes, filled with molten $Li_{17}Pb_{83}$ breeding material. The Li-Pb is recirculated to provide cooling. A study of auxiliary equipment design with low activation was also initiated in this year's program. The STARFIRE rf heating system design was used as a model for substitution of low activation materials. A MARS pump beam line is used as a model to evaluate low activation neutral beams for fusion. Aluminum alloys and Al/SiC composites provide high strength structural materials. $Al_2O_3$ and MgO are useful electrical insulators, and high purity aluminum can be substituted for copper in the magnet coils.

8001 **(IAE—3714/14) Prospects for using inductive energy storage for supplying powerful pulse magnetic systems.** Lototskij, A.P. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1982. 17p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE84703196.

The effective method of magnetic energy transfer from sectional inductive energy storage is proposed. Series connection of storage sections permits to realize nondissipative transfer of the greater part of magnetic energy. Multiple decrease of dissipated energy allows one to simultaneously increase output power. The system optimization by means of "cross-switching" of electric coils sections gives the possibility to approximate efficiency to 1.0. The test experiment results are given. The use of the new method in supplying systems of thermonuclear plants is assumed.

8002 **(ILE—8302G) Diagnostics and data acquisition system on GEKKO XII laser fusion research.** Nishimura, Hiroaki; Ido, Shunji; Niki, Hideaki; Yamanaka, Masanobu; Yamanaka, Tatsuhiko; Yamanaka, Chiyoe. (Osaka Univ., Suita (Japan). Inst. of Laser Engineering). 12 May 1983. 18p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700121.

This paper presents the experimental basis and instrumentation for GEKKO XII laser fusion program developed at the Institute of Laser Engineering (ILE), Osaka university. Physical parameters evaluated for the imploded fusion pellet demand a new region of diagnostics and detection systems. Present status and future planning of these diagnostics and data acquisition system are described.

8003 **(ILE—8303P) Impact radiative fusion concept.** Yabe, Takashi; Mochizuki, Takayasu. (Osaka Univ., Suita (Japan). Inst. of Laser Engineering). 18 Feb 1983. 15p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700122.

This letter proposes a new, fascinating ICF scheme. The scheme employs the soft x-ray production by hypervelocity projectiles. The soft x-ray of $10^{13}$ W/cm$^2$ and 10 nsec duration, which is focusable onto a small sized pellet, can be efficiently produced.

8004 (INIS-SU—259, pp 26-33) **Chamber of the Angara-5 device.** Volkov, V.G.; Gryaznov, G.M.; Gorbachev, V.N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii) (and others). 1982. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number TI85780020. (CONF-8106209—Vol.4).

From 2. all-union conference on engineering problems of thermonuclear reactors; Leningrad, USSR (23 Jun 1981).

The design of the operating chamber of the "Angara-5" experimental fusion device of the pulsed type with inertial plasma confinement, is briefly described. In this device fusion microexplosions of the spherical target containing DT mixture is initiated by 48 relativistic electron beams of the $10^{14}$ W total power. The working chamber includes explosion chamber proper which holds a microexplosion, devices of chamber connection with accelerator modules, devices of energy transport from accelerator to the target radiation shields as well as technological and control and measuring systems providing chamber preparation for a planned microexplosion. Requirements to the design of the working chamber are given. Due to analysis performed of microexplosion effect on chamber elements the following is found: - it is necessary to increase the mass of chamber head and walls; - it is necessary to introduce dapmers of oscillation processes with the aim of reducing oscillation amplitude and increasing the rate of damping; - it is necessary to place protective shields with the aim of protecting the walls of the chamber from fragments of structure elements of the target joint which is destructed during microexplosion.

8005 (INIS-SU—259, pp 61-68) **Study on the techniques for increasing the service life of a thermonuclear reactor first wall.** Kalin, B.A.; Skorov, D.M.; Yakushin, V.L. (Moskovskij Inzhenerno-Fizicheskij Inst. (USSR)). 1982. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number TI85780020. (CONF-8106209—Vol.4).

From 2. all-union conference on engineering problems of thermonuclear reactors; Leningrad, USSR (23 Jun 1981).

Some methods of increasing the resource of the first wall of the discharge chamber of thermonuclear reactors (TNR) are considered. The effect of macro- and microrelief of the surface on erosion of construction materials, is investigated. The design of TNR discharge chamber is suggested, in which the first wall or protective screen are made in the form of the sum of correct pyramids with dihedral angle between the base and the side of the pyramid more than 60 deg directed inside the chamber. The decrease of blistering can be achieved when creating microinhomogeneities on the surface, for example by mechanic polishing. The analysis of results obtained from investigation of the alloying effect on radiation surface erosion due to blister fracture or blistering has shown that from the point of view of decreasing erosion, elements increasing plasticity and considerably increasing strength characteristics of metals are most favourable. The investigations of thermal treatment effect on radiation erosion of the molybdenum TsM-6 alloy, stainless steels, nickel and vanadium alloys have shown that irrespective of the type of material, alloys have higher radiation stability in the deformed (rolled) state. It is also noted that increase of radiation surface stability can be achieved in the case of operating wall temperature above 0.4 Tsub(melt.), as well as by way of its preliminary plasma treatment of low energy ions with the dose up to (5-10)x$10^{22}$ ion/$m^2$.

8006 (INIS-SU—259, pp 249-256) **Fuel cycle of the lithium zone of the INTOR blanket.** Ershova, Z.V.; Vasil'ev, V.G.; Shulyatikov, B.V.; Yakunin, S.A. (Vsesoyuznyj Nauchno-Issledovatel'skij Inst. Neorganicheskikh Materialov, Moscow (USSR)). 1982. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number TI85780020. (CONF-8106209—Vol.4).

From 2. all-union conference on engineering problems of thermonuclear reactors; Leningrad, USSR (23 Jun 1981).

A flowsheet of tritium reproduction in lithium zone of blanket of thermonuclear reactor INTOR is suggested and described. Continuous way of tritium production without discharge of irradiated material is considered. Creation of fuel cycle of blanket lithium zone on the basis of solid inorganic materials using lithium silicates is recommended. The main physicochemical properties of lithium metha- and orthosilicates, principle flowsheets of the whole cycle and lithium channel sketch are presented.

8007 (INIS-SU—259, pp 311-318) **Blanket of a hybrid thermonuclear reactor with liquid-metal cooling.** Terent'ev, I.K.; Fedorovich, E.P.; Paramonov, P.M.; Zhokhov, K.A. (Nauchno-Proizvodstvennoe Ob"edinenie po Issledovaniyu i Proektirovaniyu Ehnergeticheskogo Oborudovaniya, (USSR)). 1982. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number TI85780020. (CONF-8106209—Vol.4).

From 2. all-union conference on engineering problems of thermonuclear reactors; Leningrad, USSR (23 Jun 1981).

Blanket design of a hybrid thermopuclear reactor with a liquid metal coolant is described. To decrease MHD-resistance for uranium zone fuel elements a cylindrical shape is suggested and movement of liquid-metal coolant in fuel element packets is presumed to be in perpendicular to the magnetic field and fuel element axes direction. The first wall is cooled by water, blanket-by lithium-lead alloy.

8008 (IPP—2/269) **Modular coil systems of the WENDELSTEIN VII-AS type with reactor dimensions.** Harmeyer, E.; Brossmann, U.; Gorenflo, H.; Kisslinger, J.; Mukherjee, S.; Raeder, J.; Rau, F.; Wobig, H. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). Aug 1983. 85p. NTIS (US Sales Only), PC A05/MF A01. File Number DE84752319.

Modular stellarator coil systems with reactor dimensions are described. They comprise 5 field periods (F.P.) with 4 to 10 twisted coils within each. Preference is given so far to a data set of 10 coils/F.P.. The coil configuration is optimized with respect to the magnetic field (B, rotational transform phi) and with respect to the available space for the blanket. Technical constraints of superconducting NbTi coils are satisfied. The forces, mechanical stresses and deformations are calculated and suitable support concepts for the coils are investigated.

8009 (IPP—2/271) **Ring-type support concept for twisted coils (finite element simulation).** Mukherjee, S.B. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). Feb 1984. 55p. NTIS (US Sales Only), PC A04/MF A01. File Number DE84752318.

A Ring-type support concept is introduced in this report. This is an alternative to the Front support system where a stellarator reactor coil (Wendelstein VII-AS type) is supported at the front region (near to the torus axis) to take up the resultant centering force. A coil is also supported sidewise to stop tilting moments. With the Ring-type support system, a coil is supported all along its circumference and sidewise as well. The twisted coils within the magnetic field are subjected to forces and moments which are complex in nature. The coils are usually sensitive to support conditions and the stresses response accordingly on how they are being supported. Applying the usual Front support concept the stresses in a coil with superimposed bending stresses may be rather high and critical with the increased magnetic forces. They may even exceed the limit of present technical feasibility. Whereas a Ring-type support system actually tends to reduce the bending moments and thus causes a considerable drop in mechanical stresses within a coil. The finite element computations have been carried out assuming a coil being a superconducting one and therefore no temperature rise within a coil may be considered. Also the forces and stresses resulting from cooling down and different thermal expansion coefficients are not treated in this report. A Ring support can either be an inward or an outward type and it is applicable also for planar coils.

8010 (IPPJ—599, pp 604-607) **Future US-Japan cooperation in burning plasma physics and engineering.** Nelson, D. (Department of Energy, Washington, DC (USA)); Miyahara, A. Jul 1982. NTIS (US Sales Only), PC A99/MF A01. File Number TI85780075. (CONF-8202103—).

From US-Japan working on burning plasma physics and engineering; Nogoya, Japan (10 Feb 1982).

8011 (IPPJ—599, pp 266-279) **Phase I design of R-tokamak.** Kitagawa, S. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Jul 1982. NTIS (US Sales Only), PC A99/MF A01. File Number TI85780075. (CONF-8202103—).

From US-Japan working on burning plasma physics and engineering; Nogoya, Japan (10 Feb 1982).

The major and minor radii of the plasma in the R-tokamak are 2.1 m and 0.6 m, respectively, and the volume of the plasma is 15 $m^3$. The number of TF coils was chosen to be 14. For additional heating in the R-tokamak, NBI is the first candidate, while RF heating is adopted as auxiliary heating. 15 MW, 120 keV deuterium beam is injected. The central ion temperature reaches 10 keV, and the central electron density becomes 2 x $10^{14}$/$cm^3$ at the end of NBI pulses. As a general philosophy, a reacting D-T machine should be as simple as possible for obtaining machine reliability and experimental accessibility. The plasma of the R-tokamak is relatively small, and its cross section is circular. The circular TF coils were adopted. The diverter was not used for impurity control. The external hybrid PF coil system was chosen. The structure of the external PF coil is simple. As for the mechanical structure, the centering force of the TF coils is supported by three thick rings. The vacuum vessel is composed of 7 thick shells and 7 bellows. A low Z axisymmetric bumper limiter was adopted for impurity control. The R-tokamak is equipped with double radiation shields of Boron concrete. The applicability of charge-exchange beam probe method for alpha-particle diagnostics and nuclear reaction method as an alternative are examined.

8012 (IPPJ—599, pp 390-452) **TFTR experimental plan.** Goldston, R. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Jul 1982. NTIS (US Sales Only), PC A99/MF A01. File Number TI85780075. (CONF-8202103—).

From US-Japan working on burning plasma physics and engineering; Nogoya, Japan (10 Feb 1982).

The TFTR experimental plan is reviewed. The basic objectives of the TFTR experiment are to produce reactor temperature

plasma, and to demonstrate fusion energy production at reactor-like fusion power density. The initial phase of operation will concentrate on obtaining the scaling of plasma confinement vs. size, temperature and beta; verifying machine performance at full parameters; and finally obtaining plasma parameters appropriate for a break-even demonstration. For this phase, the machine will be equipped with tangential injection for 0.5 sec, and inner limiters will be able to withstand 1/2 P(inj) for 0.5 sec. The present status of construction of the TFTR is described. The scenario for performing a break-even demonstration experiment with minimum activation is explained. All neutral beam design issues have been resolved. The prototype beamline has met all specification. The movable plasma limiter, bellows cover plates, and the prototype impurity control system are being constructed. PPPL will soon propose a modification to TFTR-TFET (TFTR Fusion Engineering Test) to be implemented in 1989. The TFET proposal includes long pulse ICRF heating, long pulse limiters, ICRF current drive, neutron utilization experiment, material testing, a fusion alpha confinement test experiment, possibly LHRH start-up, and some long pulse NBI, for heating and current drive.

8013 (IPPJ—599, pp 1-6) **US plans for burning plasma experiments.** Nelson, D. (Department of Energy, Washington, DC (USA)). Jul 1982. NTIS (US Sales Only), PC A99/MF A01. File Number TI85780075. (CONF-8202103—).

From US-Japan working on burning plasma physics and engineering; Nogoya, Japan (10 Feb 1982).

The first US burning plasma experiment will be the TFTR at Princeton Plasma Physics Laboratory. The initial start-up with hydrogen is expected in December, 1983. The experiment by D-T reaction will begin in 1986. Because of the lack of shielding capability, later experiment is not yet defined. The informal scientific interaction with JET (European project) is kept. The design work on the Fusion Engineering Device (FED) continues, but is delayed. US fusion laboratories collaborated with IPP-Garching on the conceptual design of Zephyr experiment. The US continues to participate in INTOR activities, and will investigate into the critical issues relevant to both INTOR and FED in coming years.

8014 (IPPJ—599, pp 7-16) **Motivation, procedures and aims of reacting plasma experiments.** Miyahara, Akira (Nagoya Univ. (Japan). Inst. of Plasma Physics). Jul 1982. NTIS (US Sales Only), PC A99/MF A01. File Number TI85780075. (CONF-8202103—).

From US-Japan working on burning plasma physics and engineering; Nogoya, Japan (10 Feb 1982).

A project of reacting plasma experiment (R-project) was proposed at the Institute of Plasma Physics (IPP), Nagoya University. It is necessary to bridge plasma physics and fusion engineering by means of a messenger wire like burning plasma experiment. This is a motivation of the R-project. The university linkage organization of Japan for fusion engineering category carried out a lot of contribution to R-tokamak design. The project consists of four items, namely, R-tokamak design, research and development (R and D), site and facilities, and international collaboration. The phase 1 experiment ($R_1$ - phase) corresponds to burning plasma experiment without D + T fuel, while the phase-2 experiment ($R_2$-phase) with D + T fuel. One reference design was finished. Intensive efforts have been carried out by the R and D team on the following items, wall material, vacuum system, tritium system, neutronics, remote control system, pulsed superconducting magnet development, negative ion source, and alpha-particle diagnostics. The problems concerning site and major facilities are also important, because tritium handling, neutron and gamma-ray sky shines and the activation of devices cause impact to surrounding area. The aims of burning plasma experiment are to enter tritium into the fusion device, and to study burning plasma physics.

8015 (IPPJ—599, pp 230-257) **Design of high performance burning plasma experiment.** Cohn, D. (Massachusetts Inst. of Tech., Cambridge (USA)). Jul 1982. NTIS (US Sales Only), PC A99/MF A01. File Number TI85780075. (CONF-8202103—).

From US-Japan working on burning plasma physics and engineering; Nogoya, Japan (10 Feb 1982).

The tokamak test reactors with high performance resistive magnets were studied. A range of the design of compact ignition test reactor (CITR) devices has been developed. The design for the ZEPHYR device was characterized by 1.3 m radius and 9.1 T magnetic field, and a horizontally elongated vacuum chamber for compression boosted start-up. The design for the devices with large ignition margin in the n-tau value of electrons is characterized by about 2 m radius and circular or D-shaped vacuum chambers. A design for a reduced size version of the ZEPHYR is characterized by about 1.2 m radius and 9 T magnetic field and a circular vacuum chamber. This device has a margin of ignition of 1 for Alcator scaling. Long pulse operation, a large device with steady state water-cooled magnets, insulator, and remote maintenance are described.

8016 (IPPJ—599, pp 258-265) **Outline of phase I of R-project.** Matsuura, K. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Jul 1982. NTIS (US Sales Only), PC A99/MF A01. File Number TI85780075. (CONF-8202103—).

From US-Japan working on burning plasma physics and engineering; Nogoya, Japan (10 Feb 1982).

The Reacting Plasma Project (R project) is the principal program of the Third Period Research Plan of the Institute of Plasma Physics, Nagoya University, and aims at studying the physics of nuclear fusion engineering with high reliability and safety for achieving D-T fusion reacting plasma. The zero phase design of the R-project was completed in 1980. Now, the R-project teams were organized, and the first phase design is in progress. The objectives of the R-project are the study of pre-burning plasma physics (scaling in the pre-burning plasma regime), and the development of basic technology related to the burning device. The D-T experiment was considered as the later phase of the project. The design principle was to make a small size tokamak with simple structure to reduce technical difficulty and cost. The H plasma experiment was considered in the first phase. As the alternative design of the R-tokamak, an Al-alloy tokamak, a high field tokamak, and a SC coil system are designed.

8017 (IPPJ—599, pp 465-488) **Long pulse considerations for burning plasma experiment.** Nelson, D. (Department of Energy, Washington, DC (USA)). Jul 1982. NTIS (US Sales Only), PC A99/MF A01. File Number TI85780075. (CONF-8202103—).

From US-Japan working on burning plasma physics and engineering; Nogoya, Japan (10 Feb 1982).

The pulse length in tokamak operation was studied. The longest time scale for tokamak operation is probably the resistive skin time. The skin diffusion depends principally upon the parallel resistivity. The skin diffusion in finite-beta toroidal plasma has been studied both analytically and numerically. For the R-tokamak parameters, the skin time was approximately 50 sec, but appreciable diffusion could be observed in the cooler edge region in a half of that time. The next longest characteristic time is that of the interatction of plasma-wall and plasma-divertor. At least, several seconds are required to reach equilibrium with the wall. Discharge cleaning and the effect of changing the working gas in tokamak also showed that the characteristic time was at least several seconds. Somewhat faster are the characteristic times for alpha particle buildup, potential formation by the loss of alpha particles, and the equilibrium of temperature and density with the heat input. These times were all approximately between 0.5 and 1.0 second, and depended on the confinement in the R-tokamak. More rapid equilibration could also be achieved by greater heating power. If confinement is better than predicted, longer pulse operation with reduced field is attractive. If confinement is poorer, higher field operation for shorter pulse length is preferred.

8018 (IPPJ—599, pp 491-516) **Poloidal S.C. coils for the medium size tokamak.** Ogasawara, T.; Momota, H.; Sato, K. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Jul 1982. NTIS (US Sales Only), PC A99/MF A01. File Number TI85780075. (CONF-8202103—).

From US-Japan working on burning plasma physics and engineering; Nogoya, Japan (10 Feb 1982).

The main purposes of this work are to investigate the a.c. loss and the stability of superconducting cables, to make a small-scale demonstration coil and to evaluate the performance of the coil in various operation modes. The basic strand of superconductor in

a cable is a NbTi multifilament composite wire with Cu/CuNi mixed matrix. Experimental studies have been made on the a.c. loss and stability of the basic strand, first level cable and second level cable under pulsing rate up to 200 T/sec. The results have confirmed the scientific feasibility of the superconducting P.F. coils with a pulse rate of 200 T/sec and a peak field of 7T. A small demonstration coil was designed, of which the inner diameter is 190 mm, the outer diameter is 458 mm, and the length is 435 mm. The cable conductor has a current carrying capacity of 10 kA at 6 T. The maximum current of this pulse magnet is 4.2 kA, the central field 4 T, and the stored energy 190 kJ. At a pulsing rate of 200 T/sec, the a.c. loss was estimated to be only 0.7 percent of the stored energy. The construction of the pulse coil and its cryostat is scheduled to be completed in the middle of March, 1982. The performance test of the coil will be made in four phases.

8019 (IPPJ—599, pp 280-299) **Nuclear radiation analysis in R-tokamak.** Hyodo, T.; Shin, K. (Kyoto Univ. (Japan)); Ogawa, Y. Jul 1982. NTIS (US Sales Only), PC A99/MF A01. File Number TI85780075. (CONF-8202103—).

From US-Japan working on burning plasma physics and engineering; Nogoya, Japan (10 Feb 1982).

The evaluation of the dose level in the proposed R-tokamak experiment is the essential problem. The nuclear radiation is estimated by using the 1-D $P_3S_8$ ANISN code, to which cylindrical and spherical models are applied. Attention is paid to the induced activity of stainless steel together with Al-alloys as the structural materials. Assuming that $10^3$ D-T shots are performed, the total neutron fluence becomes $1.6 \times 10^{16}$ n/cm$^2$ in the R-tokamak. The doses just outside the device-shielding (igloo in TFTR) and on the inner surface of the building wall are $2.6 \times 10^3$ rem/shot and $1.0 \times 10^2$ rem/shot, respectively. The induced activity of structural materials was calculated with THIDA code developed in JAERI. In the case of stainless steel, the dose rate is 4.5 mrem/h after 1 week from the spot, and decreases to 2.5 mrem/h after 3 months. As for the case of Al-alloy, the dose rate is 10 mrem/h after 1 week, but it decreases to 0.1 mrem/h after 2 weeks. The dose rate due to the additional elements in the Al-alloy was estimated. The activation of the air was calculated with 1-D ANISN code. The concentration of Ar-41 is the most important one, and is 220 pCi/cc/shot inside the device-shielding. It may be possible to enter the test cell after the cooling time of 1 day. The activation of cooling water was estimated. The dose in the environment due to the skyshine was calculated. The ceiling thickness of about 120 cm is necessary. The dose rate in the D-D discharge was also estimated.

8020 (IPPJ—599, pp 300-323) **Low activation R-tokamak with aluminum alloy.** Jul 1982. NTIS (US Sales Only), PC A99/MF A01. File Number TI85780075. (CONF-8202103—).

From US-Japan working on burning plasma physics and engineering; Nogoya, Japan (10 Feb 1982).

An aluminum alloy system is considered as an alternative of the first phase design of the R-tokamak. The 1-D calculation showed that the radiation level outside the vacuum vessel could be reduced by a factor of 30 about half a month after a D-T shot, when the aluminum alloy system is adopted instead of a stainless steel system. The aluminum system has weak mechanical strength, is highly conductive, and shows overaging effect at a certain low temperature. Accordingly, it is necessary to overcome these points. The highly conductive aluminum case leads to considerable increase in power consumption. Various problems on the toroidal coils, the vacuum system, and the limiter were studied. The optimization of the device parameters was investigated.

8021 (IPPJ—606) **Error field measurements in NBT-1M.** Iguchi, H.; Tsushima, A.; Takasugi, K.; Komori, A.; Fujiwara, M.; Ikegami, H. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Jul 1982. 26p. NTIS (US Sales Only), PC A03/MF A01. File Number DE84703210.

The error field of NBT-1M has been measured by the use of an electron beam probing. It is found that the error field is mainly produced by dipoles at coil feeders and bus bars and the toroidally averaged field error $<\Delta B/Bsub(t)>$ is $5 \times 10^{-4}$ in average over the minor cross section of the torus. It can be reduced to less than $1 \times 10^{-4}$ with a dipole field coil. An adjustable toroidal coil has been successfully tested to cancel error field coming from coil misalignment, demonstrating the possibility that machines can be constructed without field correction coils in future.

8022 (IPPJ—607) **Non-circular bumpy torus.** Tsushima, A.; Tsuchidate, H.; Kamimura, T.; Fujiwara, M.; Ikegami, H. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Jul 1982. 34p. NTIS (US Sales Only), PC A03/MF A01. File Number DE84703211.

FBumpy torus with non-circular coils is studied analytically and numerically in respect of the confinement of high energy passing particles. The minimum position r sub(Jmin) of the longitudinal invariant Jsub(") and the confinement area ssub(p) for passing particles (Vsub(")/V = 1) are calculated for the evaluation of confinement performance. As one example of non-circular bumpy tori ID bumpy torus is found to be much superior to circular one with the same aspect ratio when its value is large enough (A >= 20).

8023 (IPPJ—616) **Simulation of impurity transport in tokamaks, 1.** Amano, T.; Mizuno, J.; Kako, M. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Nov 1982. 56p. NTIS (US Sales Only), PC A04/MF A01. File Number DE84703206.

A computer code to simulate impurity transport in tokamaks are described. The code solves the coupled rate and diffusion equations for a set of plasma ions, hydrogen isotopes plus several charge states of one or more impurity elements. Neoclassical transport for all ion species including both density gradient and temperature gradient effects is used. Impurity ions and plasma ions can be either in Pfirsch-Schluter or plateau-banana regime. Anomalous transport is also considered. Several models are used for atomic rates. The source of impurity is calculated from the sputtering of limiter and wall. The rate and diffusion equations are solved by Cranck-Nicholson's implicit scheme. The Crank-Nicholson's method is compared with more accurate Gear's method and a fairly good agreement is found between the two methods.

8024 (IPPJ—617) **Direct energy input to compressor for inertial confinement fusion.** Mohri, A.; Ikuta, K.; Tazima, T. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Dec 1982. 19p. NTIS (US Sales Only), PC A02/MF A01. File Number DE84703213.

An effective driving method for ICF pellet compression is proposed where neither laser beam nor charged particle beam is necessary but a high electric pulse power is directly input into a vacant space between a heavy shell tamper and its enclosed pellet. Electrons emitted from the pellet surface produce a dense plasma and heat it to form a black body which works as a photon radiator as well as an energy reservoir. Photons irradiate the pellet surface and give an effective ablation-driven compression. This direct energy input to compressor (DEIC) can be done very efficiently and makes it easier to picture an ICF reactor.

8025 (IPPJ—618) **Study of discharge cleaning process in JIPP T-II torus by residual gas analyzer.** Noda, N.; Hirokura, S.; Taniguchi, Y.; Tanahashi, S. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Dec 1982. 23p. NTIS (US Sales Only), PC A02/MF A01. File Number DE84703207.

During discharge cleaning, it has been observed that decay time of water-vapor pressure changes when the pressure reaches a certain level. A long decay time observed in the later phase can be interpreted as a result of a slow deoxidization rate of chromium oxide, which may dominate the cleaning process in this phase. Optimization of plasma density for the cleaning is discussed comparing the experimental results on density dependence of water-vapor pressure with a result based on a zero-dimentional calculation for particle balance. One of the essential points for effective cleaning is found to be raising electron density of the plasma high enough that the dissociation loss rate of $H_2O$ is as large as the sticking loss rate. A density as high as $10^{11}$ cm$^{-3}$ is required for a clean surface condition where sticking probability is presumed to be around 0.5.

8026 **(IPPJ—623) Series lecture on advanced fusion reactors.** Dawson, J.M. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Jan 1983. 71p. NTIS (US Sales Only), PC A04/MF A01. File Number DE85700116.

The problems concerning fusion reactors are presented and discussed in this series lecture. At first, the D-T tokamak is explained. The breeding of tritium and the radioactive property of tritium are discussed. The hybrid reactor is explained as an example of the direct use of neutrons. Some advanced fuel reactions are proposed. It is necessary to make physics consideration for burning advanced fuel in reactors. The rate of energy production and the energy loss are important things. The bremsstrahlung radiation and impurity radiation are explained. The simple estimation of the synchrotron radiation was performed. The numerical results were compared with a more detailed calculation of Taimor, and the agreement was quite good. The calculation of ion and electron temperature was made. The idea to use the energy more efficiently is that one can take X-ray or neutrons, and pass them through a first wall of a reactor into a second region where they heat the material. A method to convert high temperature into useful energy is the third problem of this lecture. The device was invented by A. Hertzberg. The lifetime of the reactor depends on the efficiency of energy recovery. The idea of using spin polarized nuclei has come up. The spin polarization gives a chance to achieve a large multiplication factor. The advanced fuel which looks easiest to make go is D plus He-3. The idea of multipole is presented to reduce the magnetic field inside plasma, and discussed. Two other topics are explained.

8027 **(IPPJ—625) Measurement of the helical field of JIPP T-II.** Sometani, T.; Tanahashi, S. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Mar 1983. 10p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700120.

The measured toroidal helical field of JIPP T-II apparatus does not vanish on the geometrical axis of the helical winding of the apparatus, contrary to the expectation of a known usual theory. The result of measurement can be explained only by an improved theory.

8028 **(IPPJ—627) Numerical simulations for intense light-ion beam propagation in channel under influence of plasma inertia.** Kawata, Shigeo; Niu, Keishiro. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Mar 1983. 20p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700123.

The intense light-ion beam (LIB) propagation through a plasma channel is numerically investigated by using a two-dimensional simulation code. Analyses are given for the LIB propagation which couples with the motion of channel plasma. Although the electron back current neutralizes the LIB current under a typical beam and channel plasma condition, the Lorentz force by the electron back current expands the LIB radially. The expansion of the LIB depends strongly on the density of the channel plasma. A strong current of the order of 1 MA is shown to propagate stably in the argon plasma channel.

8029 **(IPPJ—636) Moving toroidal limiter.** Ikuta, Kazunari; Miyahara, Akira. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Jun 1983. 17p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700124.

The concept of the limiter-divertor proposed by Mirnov is extended to a toroidal limiter-divertor (which we call a moving toroidal limiter) using the stream of ferromagnetic balls coated with a low Z materials such as plastics, graphite and ceramics. An important advantage of the use of the ferromagnetic materials would be possible soft landing of the balls on a catcher, provided that the temperature of the balls is below Curie point. Moreover, moving toroidal limiter would work as a protector of the first wall not only against the vertical movement of plasma ring but also against the violent inward motion driven by major disruption because the orbit of the ball in the case of moving toroidal limiter distributes over the small major radius side of the toroidal plasma.

8030 **(IPPJ—637) Tritium breeding in DT-DD hybrid pellet for inertial confinement fusion.** Takase, Haruhiko; Kawata, Shigeo; Niu, Keishiro. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Jun 1983. 17p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700125.

The phenomenology of thermonuclear burn with a secondary reaction is investigated by using a method of numerical simulation for a DT-DD hybrid pellet with a high density. The simulation is carried out by use of a one-dimensional hydrodynamic Lagrangian code, showing the capability of tritium breeding in the hybrid pellet. The breeding ratio in the pellet is clarified to be able to exceed unity when the following two conditions are satisfied. 1) The amount of tritium is remarkably less than the amount of deuterium initially stored in the pellet, so that the amount of tritium produced by DD reactions is beyond the initial amount of tritium. 2) The pellet has a so high temperature and a so high rhoR, that the amount of tritium does not decrease anomalously through the secondary DT reaction, because the rate of DT reactions decreases as the temperature increases above 70 keV.

8031 **(IPPJ-DT—100) Operation of 125 MVA power supply facility from June 1976 to March 1982.** Ishiguro, H.; Taniguchi, Y.; Mugishima, M.; Tomida, T.; Nishikimi, J.; Kodaira, J.; Machida, T.; Soeno, H.; Tanahashi, S. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Nov 1982. 30p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. File Number DE84703212.

125 MVA power supply facility has been used since June 1976 for JIPP T-II and RFC-XX. Accumulated shot number has been reached to 70000 in March 1982. Averaged consuming power is about 2 MW, power factor is about 0.85. Maximum apparent power of 11.5 MVA (power factor 0.18) is used for 0.25 sec every shot. This facility is operated for 6 hours on Monday, for 10 hours on Tuesday to Friday and 9 hours on Saturday by three technicians. Regular inspection is carried out once a year, and once a week. 286 troubles have been occurred for this 6 years.

8032 **(JAERI—1284) Natural convection and boiling heat transfer of a liquid metal in a magnetic field.** Seki, Masahiro; Kawamura, Hiroshi. (Japan Atomic Energy Research Inst., Tokyo). Feb 1983. 53p. (In Japanese). NTIS (US Sales Only), PC A04/MF A01. File Number DE84703218.

A liquid metal is often assumed as a coolant and a breeding material of a Tokamak fusion reactor. However, many problems on the thermo-hydraulics of a liquid metal in a magnetic field are still remained to be studied. In the present report, natural convection and boiling of a liquid metal in a strong magnetic field are studied to examine a fundamental feasibility of a fusion reactor cooled by a liquid metal. In the experimental study of the natural convection, the circulation of a liquid metal was found to be surpressed even by a magnetic field parallel to the gravity. A numerical study has confirmed the conclusion drawn by the experiment. In the study of boiling heat transfer, stable boiling of a liquid metal has been found also in a strong magnetic field. The burnout heat flux hardly affected by the magnetic field. These indicate a fundamental feasibility of the liquid-metal cooling for a Tokamak fusion reactor.

8033 **(JAERI-M—83-031) Study of the reactor structure concept of the tokamak power reactor SPTR-P. Swimming pool type.** Tone, Tatsuzo; Seki, Yasushi; Minato, Akio; Yamamoto, Takashi; Kitamura, Kazunori; Nakae, Hirochika. (Japan Atomic Energy Research Inst., Tokyo). Mar 1983. 163p. (In Japanese). NTIS (US Sales Only), PC A08/MF A01. File Number DE84703204.

The reactor structure of a tokamak power reactor (SPTR-P) based on the swimming pool type reactor concept has been investigated. The reactor structure envisaged comprises first wall/blanket/vacuum vessel, water shield and cryostat vacuum chamber (belljar type) for superconducting magnets. The emphasis of the present study is placed on developing a feasible reactor structure concept of the SPTR-P and elucidating its technological key issues in view of thermomechanics, electromagnetics (plasma disruption and positional control), neutronics and joining mechanism to form a torus. The major design features are: steady state operation, R.F wave for plasma heating and current drive, solid tritium breeder material ($Li_2O$), modified austenitic stainless steel as first wall and blanket structural material, pumped limiter for ash exhaust, unified assembling of blanket and vacuum vessel and pressurized water cooling. The huge and heavy solid shield structure protecting su-

perconducting magnets which brings about great difficulties in repair and maintenance is eliminated by submerging the reactor in a water pool. The water plays a role of shielding. In addition the water shield concept reduces radioactive waste disposal and to ease radiation streaming sheilding. Key design parameters are: net electric power of 1000 MW, fusion power of 3200 MW, neutron wall loading of 3.3 MW/m², major radius of 6.9 m, plasma radius of 2.0 m, plasma elongation of 1.6, plasma current of 16 MA, total beta of 7 %, toroidal field on axis of 5.2 T.

8034 (JAERI-M—83-041, pp 119-134) **Comment for nuclear data from the FNS integral experiments.** Maekawa, Hiroshi (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Mar 1983. (In Japanese). NTIS (US Sales Only), PC A11/MF A01. File Number TI83902446. (CONF-821193—; NEANDC(J)—90/AU; INDC(JAP)—77/G).

From JAERI seminar on nuclear data; Tokai, Japan (24 Nov 1982).

Among the integral experiments that were carried out during last one year at FNS, the following three experimental results and their analyses are discribed. 1) Tritium production-rate distribution in a $Li_2O$-C assembly, 2) Angle dependent neutron leakage spectra from $Li_2O$ slab assemblies, 3) Induced activity of Type 316 stainless steel.

8035 (JAERI-M—83-041, pp 135-145) **Nuclear data problems for integral experiments at OKTAVIAN.** Takahashi, Akito (Osaka Univ., Suita (Japan). Faculty of Engineering). Mar 1983. (In Japanese). NTIS (US Sales Only), PC A11/MF A01. File Number TI83902446. (CONF-821193—; NEANDC(J)—90/AU; INDC(JAP)—77/G).

From JAERI seminar on nuclear data; Tokai, Japan (24 Nov 1982).

Problems in secondary neutron data are discussed, by comparing between integral experiments of plane or spherical assemblies, measured DDX data and their analyses. Examples are shown for Li, C, Fe and Pb. Integral experiment of graphite sphere does not agree with analysis even by using ENDF/B-V data. ENDF/B-IV data for Li and Pb should be largely improved.

8036 (JAERI-M—83-041, pp 146-170) **Present status of the nuclear data for fusion neutronics integral experiments.** Iwasaki, Shin (Tohoku Univ., Sendai (Japan). Faculty of Engineering). Mar 1983. (In Japanese). NTIS (US Sales Only), PC A11/MF A01. File Number TI83902446. (CONF-821193—; NEANDC(J)—90/AU; INDC(JAP)—77/G).

From JAERI seminar on nuclear data; Tokai, Japan (24 Nov 1982).

Present status of the nuclear cross section data for the analysis of the fusion neutronics integral experiments has briefly been described. It has been emphasized that double differential cross sections (DDX) for various nuclei have recently been measured at the source energy of about 14 MeV and comparison between the experimental data has become possible. Recent topical problem on the tritium production cross section $^{7}Li$ (n,n't) $^{4}He$ has also been discussed.

8037 (JAERI-M—83-058) **First wall erosion during a plasma disruption in tokamak.** Nakamura, Hiroo; Hiraoka, Toru; Hassanein, A.M.; Kulcinski, G.L.; Wolfer, W.G. (Japan Atomic Energy Research Inst., Tokyo). Mar 1983. 96p. NTIS (US Sales Only), PC A05/MF A01. File Number DE84703208.

This paper presents results for first wall erosion by evaporation and melting during a plasma disruption. As first wall materials, 316SS, Mo, C, SiC, and TiC are considered. The calculational model includes moving boundaries, non-equilibrium evaporation, vapor shielding, and temperature dependent material properties. The results show that the total erosion thickness depends on melt layer stability and vapor shielding. Calculations were carried out for deposition times equal to 0.1, 0.5 and 1.0 msec for a large tokamak, and equal to 5, 10 and 20 msec for INTOR and for energy densities as large as 1300 J/cm². For example, in the severe case of vapor shielding and 200 J/cm²-0.1 msec disruption, total erosion thicknesses of C, SiC, TiC and Mo are 4, 5, 6, 2 μm for the stable melt layer, and 4, 5, 25, 39 μm for the unstable melt layer. In the future, to evaluate the erosion thickness in more detail, further analyses is required for the vapor shielding Fmodel including atomic processes, chemical erosion, and the melt layer stability. Also, a better plasma experiment data base concerning energy density, deposition time, and first wall damage will be required.

8038 (JAERI-M—83-059) **Optimum configuration and operation regime of pumped limiter in INTOR.** Sugihara, Masayoshi; Saito, Seiji; Fujisawa, Noboru; Miki, Nobuharu. (Japan Atomic Energy Research Inst., Tokyo). Apr 1983. 49p. NTIS (US Sales Only), PC A03/MF A01. File Number DE84703215.

A detailed recycling model of neutral particles on the limiter surface and first wall in the one-dimensional tokamak transport code are developed. The energy of neutral particles, which flow back from the limiter chamber, is calculated by the two-dimensional Monte-Carlo neutral code, and is incorporated into the tokamak code. The optimum configuration and operation regime of the pumped limiter in INTOR are obtained. The main conclusions obtained are (1) the electron temperature in the scrape-off layer plasma decays rapidly, while the density distribution is fairly broad, (2) a considerably long limiter with a moderate pumping speed is sufficient to keep the helium accumulation in the main plasma at a desired level, (3) overall particle confinement time for helium becomes much longer than that for fuel particles, (4) the minimum amount of tritium pumped out little depends on the limiter length, if the pumping speed is appropriately adjusted so as to keep the helium accumulation at the same level, (5) the electron temperature at the boundary is 400 -- 500 eV when the fueling is performed by the realistic pellet injection or gas-puffing, (6) although the high temperature operation regime (700 -- 900 eV) can be realized by large pumping and ideal pellet injection with short limiter length, this regime will not necessarily be preferable if the heat flux and erosion of the leading edge are more critical for the engineering.

8039 (JAERI-M—83-069) **Structural design of the neutralizer for JT-60 NBI.** Matsuoka, Mamoru; Horiike, Hiroshi; Itoh, Takao; Kuriyama, Masaaki; Matsuda, Shinzaburo; Ohara, Yoshihiro; Tanaka, Shigeru; Morita, Hiroaki. (Japan Atomic Energy Research Inst., Tokyo). May 1983. 34p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. File Number DE84703214.

In addition to the general function of the neutralizer, the neutralizer for JT-60 NBI is especially designed to reduce the heat flux on a water jacket which protects a reflecting magnet from unneutralized ion beam bombardment. Therefore, the design of the neutralizer is closely related to those of nearby beam line components such as the magnet and the water jacket. In a present report, we describe the design process including the analyses of temperature and thermal stress distributions. Preliminary test results on the prototype NBI for JT-60 are also shown and are compared with the numerical analysis.

8040 (JAERI-M—83-077) **Mechanical strength evaluation of the formed bellows for the ports of the JT-60 vacuum vessel.** Takatsu, Hideyuki; Yamamoto, Masahiro; Shimizu, Masatsugu; Kimishima, Tomio; Kajiura, Soji; Owada, Kouro. (Japan Atomic Energy Research Inst., Tokyo). Jun 1983. 32p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. File Number DE84703216.

Mechanical strength of the formed bellows for the ports of the JT-60 vacuum vessel was evaluated, laying the emphasis on the fatigue strength under the torsional load. The formed bellows were designed to be loaded with the forced displacement between the vacuum vessel and the external fixed point, the atmospheric pressure and the forced torsional angle due to the electromagnetic force. Stresses caused by the former two were estimated following the formulae proposed by the Kellogg Company. On the other hand, the formulae were established to estimate the stress caused by the last, after examining experimentally the behavior of the formed bellows under the torsional load. In this experiment, it was shown that buckling of the formed bellows can be observed even under a small torsional angle and the newly proposed formulae was valid

under the torsional angle in the vicinity of the critical buckling one. The present mechanical strength evaluation method was applied to the formed bellows for the ports of the JT-60 vacuum vessel and it was confirmed that they have sufficient strength in the range of the design load conditions.

8041 **(JAERI-M—83-087) Experimental studies on scattered particle phenomena during in-situcoating process.** Abe, Tetsuya; Obara, Kenjiro; Yokokura, Kenji; Hasegawa, Kooichi; Okano, Fuminori. (Japan Atomic Energy Research Inst., Tokyo). Jun 1983. 19p. (In Japanese). NTIS (US Sales Only), PC A02/MF A01. File Number DE84703209.

Experiments were made to study the mechanism of the particle scattering phenomena during in-situ coating using models of liners and RF launchers for JT-60. The experimental results indicate that the particle scattering phenomena are due to the collision scattering between coating particles and surrounding gas in a vacuum. Under a condition of P sub(Ar) = 8 x $10^{-3}$Pa, most of the evaporated particles go straight to the direction of projection, however small amount of particles are scattered within +- 25° from the direction of projection. The degree of scattered particles can be expressed by a semi-empirical equation.

8042 **(JAERI-M—83-102) Design of the foundation components for the JT-60 tokamak machine.** Takatsu, Hideyuki; Shimizu, Masatsugu. (Japan Atomic Energy Research Inst., Tokyo). Jun 1983. 56p. (In Japanese). NTIS (US Sales Only), PC A04/MF A01. File Number DE84703205.

Design of the foundation components for the JT-60 tokamak machine is described, laying the emphasis on the structural and mechanical design. Foundation components are classified into four groups: central base, foundation base, support base of the vacuum vessel and star-shaped truss base. The former three are embedded in the first floor of the experimental building and the last in the wall of the building. Each foundation component is composed of the sole plates, the anchor bolts, the anchor plates and the anchor pipes. Foundation components support the weight of the machine and several kinds of the load acting on the machine such as the electromagnetic force, as well as provide the cardinal surface to assemble the machine with a high accuracy. Final design showed the structural integrity of all of the foundation components under the designed load conditions.

8043 **(JAERI-M—83-213) Conceptual design of fusion experimental reactor (FER). Option A.** (Japan Atomic Energy Research Inst., Tokyo). Jan 1984. 1029p. (In Japanese). NTIS (US Sales Only), PC A99/MF A01. File Number DE85700117.

Composed of two volumes.

Conceptual Design of Fusion Experimental Reactor (FER) of which the objective will be to realize self-ignition with the D-T reaction is reported. Mechanical Configurations of FER are characterized with a noncircular plasma and a double-null divertor. The primary aim of design studies is to demonstrate fissibility of reactor structures as compact and simple as possible with removable torus sectors. The structures of each component such as a first-wall, blanket, shielding, divertor, magnet and so on have been designed. It is also discussed about essential reactor plant system requirements. In addition to the above, a brief concept of a steady-state reactor based on RF current drive is also discussed. The main aim, in this time, is to examine physical studies of a possible RF steady-state reactor.

8044 **(JAERI-M—83-214) Conceptual design of fusion experimental reactor (FER). Option B.** (Japan Atomic Energy Research Inst., Tokyo). Feb 1984. 861p. (In Japanese). NTIS (US Sales Only), PC A99/MF A01. File Number DE85700118.

Composed of two volumes.

This report describes the engineering conceptual design of Fusion Experimental Reactor (FER) which is to be built as a next generation tokamak machine. This design covers overall reactor systems including MHD equilibrium analysis, mechanical configuration of reactor, divertor, pumped limiter, first wall/breeding blanket/shield, toroidal field magnet, poloidal field magnet, cryostat, electromagnetic analysis, vacuum system, power handling and conversion, NBI, RF heating device, tritium system, neutronics, maintenance, cooling system and layout of facilities. The engineering comparison of a divertor with pumped limiters and safety analysis of reactor systems are also conducted.

8045 **(JAERI-M—83-215) Conceptual design of fusion experimental reactor (FER). Option C.** (Japan Atomic Energy Research Inst., Tokyo). Mar 1984. 874p. (In Japanese). NTIS (US Sales Only), PC A99/MF A01. File Number DE85700119.

Composed of two volumes.

A conceptual design study (option C) has been carried out for the fusion experimental reactor (FER). In addition to design of the tokamak reactor and associated systems based on the reference design specifications, feasibility of a water-shield reactor concept was examined as a topical study. The design study for the reference tokamak reactor has produced a reactor concept for the FER, along with major R D items for the concept, based on close examinations on thermal design, electromagnetics, neutronics and remote maintenance. Particular efforts have been directed to the area of electromagnetics. Detailed analyses with close simulation models have been performed on PF coil arrangements and configurations, shell effects of the blanket for plasma position unstability, feedback control, and eddy currents during disruptions. The major design specifications are as follows; Peak fusion power 437 MW Major radius 5.5 m Minor radius 1.1 m Plasma elongation 1.5 Plasma current 5.3 MA Toroidal beta 4 % Field on axis 5.7 T.

8046 **(Juel—1885) Design data, liquid distributors and condenser for a distillation column to enrich tritium in metallic lithium.** Barnert, E. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Chemische Technologie der Nuklearen Entsorgung; Association Euratom-Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.)). Jan 1984. 40p. (In German). NTIS (US Sales Only), PC A03/MF A01. File Number DE84752310.

Tritium, one fuel component of the fusion reactor is bred from the reactors blanket material lithium. Before extracting the tritium from, for instance, metallic lithium by permeation it has to be enriched in the lithium by high temperature distillation. In this report design data for a column for high temperature distillation are given. About the testing of two distributors for small liquid quantities and of a condenser is reported.

8047 (KEK—82-3, pp 61-68) **Present status of vacuum system in the design of nuclear fusion experimental reactor.** Nakamura, Kazuyuki; Murakami, Yoshio (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Jun 1982. (In Japanese). NTIS (US Sales Only), PC A09/MF A01. File Number TI85780074. (CONF-8203186—).

From 4. meeting on ultra high vacuum techniques for accelerators and storage rings; Oho, Ibaraki, Japan (12 Mar 1982).

Large Tokamak devices have come to such stage that they will be completed pleted within 2 or 3 years. On the other hand, the investigation of Tokamak devices at experimental reactor level, called "next phase device", has become active lately. In nuclear fusion experimental reactors, the following problems seem to be newly added to those of conventional nuclear fusion devices: exhausting a large volume of helium generated as a result of D-T reaction, treating a large amount of tritium, and the necessity for developing better radiation-resistant pumps specifically for operation under strong radiation. In addition, the problems including the establishment of leak detection and repair techniques and vacuum measurement exist. Thus it is no exaggeration to say that the overcoming of vacuum engineering difficulties decides the fate of nuclear fusion reactors. The vacuum system for nuclear fusion reactors is roughly divided into three systems of torus, neutral beam injector and cryostat, each having different problems. The most difficult problem of each system is the handling of a large volume of helium and tritium, the necessity of large evacuation rate for hydrogen, and the large and complex construction of vacuum chambers, respectively. The cryo-sorption system, mercury diffusion pump system and turbo-molecular pump system are considered for the

torus vacuum system, and the cryo-sorption system is presently most promising.

8048 (KEK—82-3, pp vp) **Basic experiment of leak detection for large vacuum systems.** Obara, Kenjiro; Abe, Tetsuya; Murakami, Yoshio (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Jun 1982. NTIS (US Sales Only), PC A09/MF A01. File Number TI85780074. (CONF-8203186—).

From 4. meeting on ultra high vacuum techniques for accelerators and storage rings; Oho, Ibaraki, Japan (12 Mar 1982).

A vacuum test system (JVX-2) was designed to make the leak detection of large vacuum systems. The design principle of this test system is to detect directly the air which leaks into vacuum vessels from outside of the vessel walls. Probe gas is not used. The JVX-2 consists of a vacuum vessel, a manipulator, and a vacuum pumping system. The baking of the system can be done up to 500 degree C. A uni-directional detector (sensor) is set to the manipulator. Experiment was made with simulated leak. Gas from the leak was detected by moving the sensor. The results of experiment showed that the detection of leak was able to be made by the sensor in the vessel. Special probe gas is not required for the leak detection. The detection sensitivity can be changed by the driving speed of the manipulator and the size of the inlet tube of the sensor. The minimum detectable leak was $5.4 \times 10^{-9}$ Torr.Fl/s (He). The accuracy of positioning of leak was 20 mm for linear scanning and 10 degree for rotating scanning.

8049 (KEK—82-3, pp 171-174) **Outgassing characteristics of TiC coated materials.** Sukenobu, S.; Gomay, Y. (Toshiba Corp., Kawasaki, Kanagawa (Japan). Research and Development Center). Jun 1982. NTIS (US Sales Only), PC A09/MF A01. File Number TI85780074. (CONF-8203186—).

From 4. meeting on ultra high vacuum techniques for accelerators and storage rings; Oho, Ibaraki, Japan (12 Mar 1982).

The outgassing characteristics of TiC-coated materials (POCO graphite, and molybdenum) were studied. In the case of molybdenum substrate, thin TiN layer was coated before TiC coating to avoid molybdenum carbide formation. The outgassing characteristics of the sample materials were studied by a baking process at 250 degree C for 24 hours. The samples were inserted in a 304 stainless steel vacuum chamber with a thin aperture, and the gas through-put from this chamber was estimated by measuring the pressure before and after the aperture. A residual gas analyzer was installed on the low pressure side of the aperture. It can be concluded that the out-gassing rate of these TiC-coated materials was about $10^{-12}$ Torr.Fl/s.Fcm$^2$ after baking at 250 degree C for 24 hours. Residual gas analysis showed that the main outgas species were $H_2$ and CO after baking. The TiC-coated POCO graphite and molybdenum are applicable to fusion devices as far as the outgassing characteristics are concerned.

8050 (KFK—3755) **Some considerations on tritium control in a helium cooled ceramic blanket for the NET reactor.** Dalle Donne, M.; Dorner, S. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Neutronenphysik und Reaktortechnik; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Kernfusion). Jun 1984. 44p. (EUR—7993e). NTIS (US Sales Only), PC A03/MF A01. File Number DE84752309.

Since 1983 the Karlsruhe Nuclear Research Center is investigating the technological problems of helium cooled ceramic blankets for fusion reactors. Various solutions have been so far investigated: poloidal, toroidal or lobular arrangement of the pressure tubes containing the breeder material and the cooling helium; lead multiplier integral with the first wall or beryllium in the ceramic breeder region. For all these designs crucial is the requirement to maintain the tritium losses from the plant equal or below 10 curie/d. This requires a helium purge flow completely separated from the main helium coolant flow. If the helium pressure in the purge system is only slightly lower than the pressure in the main coolant circuit (80 bar for the poloidal arrangement and 50 bar for the toroidal or lobular arrangement of the pressure tubes) tritium containement requires an oxidizing atmosphere in the purge flow region.

8051 (KURRI-TR—229, pp 8-15) **Nuclear fusion reactor material data base.** Iwata, Shuichi (Tokyo Univ. (Japan). Faculty of Engineering). Sep 1982. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. File Number TI85780076.

In Nuclear science information and on-line processing of literature search, (2).

The working conditions for the materials to be used for nuclear fusion reactors are many sided, complicated and harsh. The existing experimental results can not be employed directly for reactor design. In such a case, it is insufficient to simply accumulate the experimental data on the specific properties of specific materials, and it is necessary to predict the material behaviour in the reactor system by rearranging those data in accordance with the purpose. When extreme characteristics are frequently pursued, wide insight is necessary regarding from the fundamental theory to the testing of practical equipment. In the development of nuclear fusion reactor materials, it is especially important to satisfy the condition that the design purpose of the system for selecting the optimum materials should be fully understood. A new material engineering approach has become necessary, in which a barrier existing so far between materials and the design is removed. From this viewpoint, the specifications, present status and design and development of material data base presently under development, the use of the data base made for trial, and the interface of material development and nuclear fusion reactor design, are described. In this data base, most of the data handle literature data, and the event data base mainly composed of experimental data is very few, similarly to other fields. Data modification will be necessary to respond the questions of users.

8052 (LBL—18008) **$H^-$ ion production from different converter materials.** Leung, K.N.; Ehlers, K.W. (Lawrence Berkeley Lab., CA (USA)). Oct 1984. Contract AC03-76SF00098. 8p. (CONF-841218—8). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003457.

From 31. national vacuum symposium; Reno, NV, USA (3 Dec 1984).

For heating plasmas and for current drive in some fusion reactors, high energy neutral beams may be required. The high neutralization efficiency of $H^-$ or $D^-$ ions makes them favorable to form neutral atoms with energies in excess of 160 keV. It has been shown that a steady-state $H^-$ ion beam with current greater than 1 A can be generated by a surface conversion type source with Mo being used as the converter material. In order to achieve the proper cesium coverage and thereby increasing the $H^-$ ion yield, the application of porous cesium-dispensing converters is being investigated. It is also possible to optimize the $H^-$ production by choosing the proper converter material. In this paper, we compare the negative ion yield generated by different materials (such as Mo, Ti, V, Nb, Pt, Pd, Rh, Cu, Ta, Al, Au, $LaB_6$ and stainless-steel) in the pure hydrogen and cesium-hydrogen modes of operation.

8053 (LBL—18016) **Negative lithium emission from a tungsten surface in a plasma.** Stearns, J.W.; Pyle, R.V. (Lawrence Berkeley Lab., CA (USA)). Oct 1984. Contract AC03-76SF00098. 7p. (CONF-841218—7). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003456.

From 31. national vacuum symposium; Reno, NV, USA (3 Dec 1984).

Three possibilities for making $Li^-$ ions have been considered: electron capture in a suitable gas or vapor, extraction from a lithium plasma, and production on a low work function surface in a plasma. The only quantitative results, so far, have been for electron capture, with the highest yield being about 5% for $Li^+$ in Cs vapor at 5 keV. Of the other two methods, Leung has seen some $Li^-$ produced in the volume of a plasma, and we now report the observation of $Li^-$ from a surface in a He-Li plasma.

8054 (LBL—18530) **Collisional pumping for the production of intense spin-polarized, neutral beams: target considerations.** Stearns, J.W.; Burrell, C.F.; Kaplan, S.N.; Pyle, R.V.; Ruby, L.; Schlachter, A.S. (Lawrence Berkeley Lab., CA (USA)). Oct 1984. Contract AC03-76SF00098. 5p. (CONF-850310—10). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003459.

From 6. topical meeting on the technology of fusion energy; San Francisco, CA, USA (3 Mar 1985).

We have recently proposed a new method for the production of nuclear-spin-polarized ions and atoms. A fast beam of atoms is pumped to a single spin state by means of successive capture of a spin-polarized electron followed by the loss of an electron, in a highly electron-spin-polarized medium. This process, which we call collisional pumping, is characterized by the transfer of the electron spin to the nucleus through hyperfine interactions whenever the atom is in a neutral state. We anticipate that fast polarized beams of 1A or more can be produced, with possible applications to accelerators and fusion research. This process can be accomplished by passage of a low-energy (~ 1 keV/u) $H^+$ ($D^+$,$T^+$) beam through a polarized alkali-metal-vapor target of about $10^{16}$ electron-spin-polarized atoms/cm$^2$. The only bound state of a negative hydrogen ion is a singlet state, which provides a selection mechanism by making electron attachment impossible when the projectile and target electrons have the same spin.

8055 **(ORNL/FEDC—83/11) Analysis of tandem mirror reactor performance.** Wu, K.F.; Campbell, R.B.; Peng, Y.K.M. (Oak Ridge National Lab., TN (USA)). Nov 1984. Contract AC05-84OR21400. 38p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85004387.

Parametric studies are performed using a tandem mirror plasma point model to evaluate the wall loading $\Gamma$ and the physics figure of merit, Q (fusion power/injected power). We explore the relationship among several dominant parameters and determine the impact on the plasma performance of electron cyclotron resonance heating in the plug region. These global particle and energy balance studies were carried out under the constraints of magnetohydrodynamic (MHD) equilibrium and stability and constant magnetic flux, assuming a fixed end-cell geometry. We found that the higher the choke coil fields, the higher the Q, wall loading, and fusion power due to the combination of the increased central-cell field B/ sub c/ and density n/sub c/ and the reduced central-cell beta $\beta$/sub c/. The MHD stability requirement of constant B/sub c/$^2\beta$/sub c/ causes the reduction in $\beta$/sub c/. In addition, a higher value of fusion power can also be obtained, at a fixed central-cell length, by operating at a lower value of B/sub c/ and a higher value of $\beta$/sub c/.

8056 **(ORNL/TM—7906) Observations of low frequency plasma fluctuations in ELMO Bumpy Torus.** Komori, A. (Oak Ridge National Lab., TN (USA)). Oct 1984. Contract AC05-84OR21400. 55p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85003796.

In the ELMO Bumpy Torus (EBT) plasma, two types of low frequency fluctuations have been identified in the frequency range of dc up to 1 MHz: a drift-type fluctuation and an interchange instability. The latter, which leads to an unstable toroidal plasma, is prominently excited in the outer plasma along the hot electron ring. In the proper neutral pressure regime, the hot electon rings prevent these two fluctuations from growing and permit the establishment of a stable toroidal plasma.

8057 **(ORNL/TM—9183) Numerical model for swirl flow cooling in high-heat-flux particle beam targets and the design of a swirl-flow-based plasma limiter.** Milora, S.L.; Combs, S.K.; Foster, C.A. (Oak Ridge National Lab., TN (USA)). Nov 1984. Contract AC05-84OR21400. 22p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003824.

An unsteady, two-dimensional heat conduction code has been used to study the performance of swirl-flow-based neutral particle beam targets. The model includes the effects of two-phase heat transfer and asymmetric heating of tubular elements. The calorimeter installed in the Medium Energy Test Facility, which has been subjected to 30-s neutral beam pulses with incident heat flux intensities of $\geqq$ 5 kW/cm$^2$, has been modeled. The numerical results indicate that local heat fluxes in excess of 7 kW/cm$^2$ occur at the water-cooled surface on the side exposed to the beam. This exceeds critical heat flux limits for uniformly heated tubes wih straight flow by approximately a factor of 5. The design of a plasma limiter based on swirl flow heat transfer is presented.

8058 **(ORNL/TM—9300) Optimized Fourier representations for three-dimensional magnetic surfaces.** Hirshman, S.P.; Meier, H.K. (Oak Ridge National Lab., TN (USA)). Nov 1984. Contract AC05-84OR21400. 36p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85003831.

The selection of an optimal parametric angle $\theta$ describing a closed magnetic flux surface is considered with regard to accelerating the convergence rate of the Fourier series for the Cartesian coordinates x($\theta$,phi) identical with R - $R_0$ and y($\theta$,phi) identical with Z - $Z_0$. Geometric criteria are developed based on the Hamiltonian invariants of Keplerian orbits. These criteria relate the rate of curve traversal (tangential speed) to the curvature (normal acceleration) so as to provide increased angular resolution in regions of largest curvature. They are, however, limited to either convex or starlike domains and do not provide rapid convergence for complex domains with alternating convex and concave regions. A generally applicable constraint criterion, based directly on minimizing the width of the x and y Fourier spectra, is also derived. A variational principle is given for implementing these constraints numerically. Application to the representation of three-dimensional magnetic flux surfaces is discussed.

8059 **(PPPL—2158) Experimental observations of the coupling between induced currents and mechanical motion in torsionally supported square loops and plates. Part 1. Experimental analysis.** Weissenburger, D.W.; Bialek, J.M.; Cargulia, G.J.; Ulrickson, M.; Knott, M.J.; Turner, L.R.; Wehrle, R.B. (Princeton Univ., NJ (USA). Plasma Physics Lab.; Argonne National Lab., IL (USA)). Nov 1984. Contract AC02-76CH03073. 52p. (ANL/FPP—84-2). NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85004401.

This two-part report describes a series of experiments designed to provide quantitative data on coupled magnetomechanical systems. This first part presents the details of the data analysis, some representative data, the overall results, and conclusions. The Fusion Electromagnetic Induction Experiment (FELIX) facility is described at the Argonne National Laboratory (ANL), where the experiments were performed, and the test fixture which was designed for this investigation. The next section describes the static and dynamic mechanical tests which were performed with the test fixture and summarizes the results. The sixth section presents and summarizes the results of the tests which were made with the dipole field only, which produces no mechanical rotation. The total electric current flowing around a test piece was measured versus time using a Rogowski coil. The seventh section presents and summarizes the results of actual coupled tests which were made with both the dipole field and solenoid field. Both the test piece Rogowski coil and the rotational transducer were employed for these tests.

8060 **(PPPL—2161) Forced magnetic reconnection.** Hahm, T.S.; Kulsrud, R.M. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Nov 1984. Contract AC02-76CH03073. 33p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85004396.

By studying a simple model problem, we examine the time evolution of magnetic field islands which are induced by perturbing the boundary surrounding an incompressible plasma with a resonant surface inside. We find that for sufficiently small boundary perturbations, the reconnection and island formation process occurs on the tearing mode time scale defined by Furth, Killeen, and Rosenbluth. For larger perturbations the time scale is that defined by Rutherford. The resulting asymptotic equilibrium is such that surface currents in the resonant region vanish. A detailed analytical picture of this reconnection process is presented.

8061 **(UCID—20242) Dynamic analysis of the Nova Target Chamber to assess alignment errors due to ambient noise.** McCallen, D.B.; Murray, R.C. (Lawrence Livermore National Lab., CA (USA)). 3 Oct 1984. Contract W-7405-ENG-48. 34p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85003664.

We performed a study to determine the dynamic behavior of the Nova Target Chamber. We conducted a free vibration analysis to determine the natural frequencies of vibration and the corre-

sponding modeshapes of the target chamber. Utilizing the free vibration results, we performed forced vibration analysis to predict the displacements of the chamber due to ambient vibration. The input support motion for the forced vibration analysis was defined by a white noise acceleration spectrum which was based on previous measurements of ground noise near the Nova site. A special purpose computer program was prepared to process the results of the forced vibration analysis. The program yields distances by which the lines of sight of the various laser beams miss the target as a result of ambient vibrations. We also performed additional estimates of miss distance to provide bounds on the results. A description of the finite element model of the chamber, the input spectrum, and the results of the analyses are included.

8062 **(UCID—20257) Design alternatives for cryogenic beryllium windows in an ICF cryostat.** Pitts, J.H.; Landon, P.R.; Gerhard, M.A. (Lawrence Livermore National Lab., CA (USA)). Nov 1984. Contract W-7405-ENG-48. 21p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85003094.

We propose three backup design options for the cryogenic beryllium windows in a cryostat. The first, a beryllium flange option, reduces peak tensile stresses to 1/3 of that in the original design. The second, a fiberglass flange option, reduces peak tensile stresses to 1/2 of that in the original design and is also low cost. A third option, replacing the beryllium windows with spherical Mylar caps, would require a development program. Even though Mylar has been used previously at cryogenic temperature, this option is still considered unreliable. The near-zero ductility of beryllium at cryogenic temperature makes the reduction of peak tensile stresses particularly desirable. The orginal window design did function satisfactorily and the backup options were not needed. However, these options remain open for possible incorporation in future cryostat designs.

8063 **(UCLA-ENG—8437) Quasi-thermodynamic prediction of hydrogen reemission behavior from titanium films.** Hirooka, Y.; Conn, R.W.; Goebel, D.M. (California Univ., Los Angeles (USA). Center for Plasma Physics and Fusion Engineering). Oct 1984. Contract AT03-84ER52104;AT03-80ER52062. 38p. (PPG—826). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85003667.

A simple method is proposed to describe the hydrogen reemission behavior from a reactive metal film in which the implanted hydrogen concentration may exceed the dilute solution range under some conditions. In this method, the conventional thermodynamic information for the metal system, namely, the phase diagram and the P-C-T (Pressure-Concentration-Temperature) relation, is used extensively to determine the reemitted hydrogen flux. As a specific case, this method has been applied to the hydrogen reemission from a titanium film.

8064 **(UCRL—15632) Cascade: a review of heat transport and plant design issues.** Murray, K.A.; McDowell, M.W. (Energy Technology Engineering Center, Canoga Park, CA (USA)). 31 Jul 1984. Contract W-7405-ENG-48. 49p. (ETEC—84-20; SANL—322-006). NTIS, PC A03/MF A01. File Number DE85003660.

A conceptual heat transfer loop for Cascade, a centrifugal-action solid-breeder reaction chamber, has been investigated and results are presented. The Cascade concept, a double-cone-shaped reaction chamber, rotates along its horizontal axis. Solid $Li_2O$ or other lithium-ceramic granules are injected tangentially through each end of the chamber. The granules cascade axially from the smaller radii at the ends to the larger radius at the center, where they are ejected into a stationary granule catcher. Heat and tritium are then removed from the granules and the granules are reinjected into the chamber. A 50% dense $Li_2O$ granule throughput of 2.8 $m^3/s$ is transferred from the reaction chamber to the steam generators via continuous bucket elevators. The granules then fall by gravity through 4 vertical steam generators. The entire transport system is maintained at the same vacuum conditions present inside the reaction chamber.

8065 (UCRL—52000-84-10, pp 12-23) **Uranium resources and the development of fission and fusion breeder reactors.** Oct 1984. NTIS, PC A03/MF A01. File Number TI85003245.

In Energy and Technology Review.

According to present estimates, economically useful supplies of uranium will be exhausted in about 60 to 70 years if the US nuclear power industry recovers from its present slump. To allow time to build enough replacement plants, it will be necessary to develop some other source of energy long before this happens. Our studies indicate that it will be difficult to develop an economically competitive fission breeder reactor in time to ease the shortage. Hybrid fusion reactors, however, each of which might make enough fuel for 5 to 20 light-water reactors, appear to offer a safe and cost-effective alternative. Research to develop the breeding blankets for such hybrid reactors should start as soon as possible.

8066 **(UCRL—53516) Preparation and properties of hollow glass microspheres for use in laser fusion experiments.** Campbell, J.H.; Grens, J.Z.; Poco, J.F. (Lawrence Livermore National Lab., CA (USA)). 1 Nov 1983. Contract W-7405-ENG-48. 65p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85003485.

We review the preparation of high quality, hollow-glass microspheres for use in laser driven fusion experiments at LLNL. The primary focus of this paper is on the liquid-droplet method for making glass spheres, which has been in use at LLNL for over six years. We have combined the results from previous studies with our current results to present a detailed description of the preparation and the composition and physical properties of the glass microspheres. We also present a mathematical model that simulates the microsphere formation process. Examples are given of the application of the model to study the effects of various process parameters.

8067 **(UCRL—53571) Potential of high-average-power solid state lasers.** Emmett, J.L.; Krupke, W.F.; Sooy, W.R. (Lawrence Livermore National Lab., CA (USA)). 25 Sep 1984. Contract W-7405-ENG-48. 53p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85003884.

We discuss the possibility of extending solid state laser technology to high average power and of improving the efficiency of such lasers sufficiently to make them reasonable candidates for a number of demanding applications. A variety of new design concepts, materials, and techniques have emerged over the past decade that, collectively, suggest that the traditional technical limitations on power (a few hundred watts or less) and efficiency (less than 1%) can be removed. The core idea is configuring the laser medium in relatively thin, large-area plates, rather than using the traditional low-aspect-ratio rods or blocks. This presents a large surface area for cooling, and assures that deposited heat is relatively close to a cooled surface. It also minimizes the laser volume distorted by edge effects. The feasibility of such configurations is supported by recent developments in materials, fabrication processes, and optical pumps. Two types of lasers can, in principle, utilize this sheet-like gain configuration in such a way that phase and gain profiles are uniformly sampled and, to first order, yield high-quality (undistorted) beams. The zig-zag laser does this with a single plate, and should be capable of power levels up to several kilowatts. The disk laser is designed around a large number of plates, and should be capable of scaling to arbitrarily high power levels.

8068 **(UCRL—90848) Modal testing and analysis of NOVA laser structures.** Burdick, R.B.; Weaver, H.J.; Pastrnak, J.W. (Lawrence Livermore National Lab., CA (USA)). Sep 1984. Contract W-7405-ENG-48. 6p. (CONF-850118—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE84017569.

From 3. international modal analysis conference; Orlando, FL, USA (28 Jan 1985).

NOVA, currently the world's most powerful laser system, is an ongoing project at the Lawrence Livermore National Laboratory in California. The project seeks to develop a feasible method of achieving controlled fusion reaction, initiated by multiple laser beams targeted on a tiny fuel pellet. The NOVA system consists of

several large steel framed structures, the largest of which is the Target Chamber Tower. In conjunction with design engineers, the tower was first modelled and analyzed by sophisticated finite element techniques. A modal test was then conducted on the tower structure to evaluate its vibrational characteristics and seismic integrity as well as for general comparison to the finite element results. This paper will discuss the procedure used in the experimental modal analysis and the results obtained from that test.

8069 **(UCRL—91174) Measurement of hot-electron production and microwave emission by laser-irradiated CH targets.** Heidrich, J.E.; Ault, S.K.; Koehler, H.A.; Pollaine, S.M.; Slivinsky, V.W.; Zacharias, R.A.; Kilkenny, J.D. (Lawrence Livermore National Lab., CA (USA); Imperial Coll. of Science and Technology, London (UK)). Oct 1984. Contract W-7405-ENG-48. 35p. (CONF-841010—9). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85003139.

From Meeting of the Plasma Physics Division of the American Physical Society; Boston, MA, USA (27 Oct 1984).

This work was an experimental study on hot-electron production and microwave emission by laser irradiated targets. The laser was a neodymium glass laser (1.06-μm wavelength). Typically the laser beam consisted of a weak 3-mJ prepulse followed by a strong 30-J main pulse 8ns later. Both pulses had a temporal duration of 150 psec and were focused to a 30-μm diameter spot. The majority of the data presented were obtained using exploding-foil-type targets, which had either copper or tin foils attached to the side pointed away from the laser. These foils emitted x-rays that were used to diagnose hot electron temperature, energy and transport. Other targets used were plastic, brass, and copper disks. Specific goals of the experiment included: measurement of the hot-electron temperature and energy, determination of how the hot electrons spread from the point of their generation, and measurement of the microwave energy spectrum and total energy emitted from the targets.

8070 **Gas pressure in the end plug regions of the TMX-U thermal barrier experiment.** Turner, W.C.; Nexsen, W.E.; Allen, S.L.; Hooper, E.B.; Hunt, A.L.; Lang, D.D.; Margolies, D.S.; Pickles, W.L.; Simonen, T.C. (Lawrence Livermore National Laboratory, University of California, Livermore, California 94550). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **2**: No. 4, 1576-1582(Oct 1984). Contract W-7405-ENG-48.

We consider briefly the upper bound on background pressure (0.5 to 1.0 x $10^{-6}$ Torr) that is required for operation of the thermal barrier end plugs of TMX-U and propose a rate equation for pressure buildup that includes terms for neutral beam injection and wall reflux. During early operation of TMX-U the background pressure exceeded this upper bound; in addition, axial end plugging of plasma losses seemed limited by the excessive pressure. Modifications to the vacuum system to decrease this pressure to the desired range are described. Furthermore, wall reflux is shown to depend linearly on pressure. We conclude with an example of the dramatic increase in time duration of axial plugging of plasma losses with the reduced background pressure.

8071 **Deuterium beam species measurement by D-D fusion product analysis.** Markevich, D.; Smith, R.R. (Lawrence Berkeley Lab., CA). *Nuclear Instruments and Methods in Physics Research, Section B: Beam Interactions with Materials and Atoms;* **232**: No. 3, 388-392(Aug 1984).

Results are discussed for a diagnostic method of determining molecular composition of ions exiting an 80-keV high-power ion source designed for neutral-beam heating in controlled fusion research. By viewing the charged products of a d-d reaction from a deuterium beam in a deuterium gas target, one can calculate the proportion of full, half, and a third energy products extracted from the accelerator.

8072 **Fiscal Year 1985 Department of Energy Authorization: magnetic fusion energy. Volume V. Hearings before the Subcommittee on Energy Research and Production of the Committee on Science and Technology, US House of Representatives, Ninety-Eighth Congress, Second Session, February 23, 29, 1984.** Washington, DC, USA; Government Printing Office (1984). 266p.

Volume V of the hearing record covers two days of testimony on the fusion energy program, with a focus on the Tokamak fusion core experiment (TFCX) and the need for the US to retain leadership in the field. DOE Research Director Trivelpiece reviewed the program on the first day. Progress reports from research laboratories and associated industries supported the request for additional funding for the TFCX. The threat of funding cuts due to the federal deficit was a major point of concern, while the potential for industrial participation was seen as a positive development. Two appendices with additional statements and responses to questions follow the testimony of 13 witnesses.

8073 **Effect of capacitive stored energy on neutral beam accelerator performance.** Owren, H.M.; Baker, W.R.; Berkner, K.H.; Hopkins, D.B.; Massoletti, D.J. (Lawrence Berkeley Lab., CA (USA)). pp 455-460 of Fusion technology 1982. Proceedings of the 12. symposium held in Juelich, 13-17 September 1982. Vol. 1 of 2 volumes. Oxford, England; Pergamon Press (1983). (CONF-820948—).

From 12. symposium on fusion technology; Juelich, F.R. Germany (13 Sep 1982).

Price Pound 125.00.

The results of tests to determine the effects of capacitive stored energy (1/2 $CV^2$) on the performance of neutral beam injectors are reported. Typical fault current waveforms and methods to limit fault current are presented. Tests indicate that deterioration of performance is not only a function of peak stored energy but is also dependent on peak current and the characteristics of the breakdown.

8074 **TFTR neutral beam power system.** Winje, R.A. (Princeton Univ., NJ (USA)). pp 475-480 of Fusion technology 1982. Proceedings of the 12. symposium held in Juelich, 13-17 September 1982. Vol. 1 of 2 volumes. Oxford, England; Pergamon Press (1983). (CONF-820948—).

From 12. symposium on fusion technology; Juelich, F.R. Germany (13 Sep 1982).

Price Pound 125.00.

The TFTR Neutral Beam Power System (NBPS) consists of the accelerator grid power supply and the auxiliary power supplies required to operate the TFTR 120 keV ion sources. The current configuration of the NBPS including the 11 MVA accelerator grid power supply and the Arc and Filament power supplies isolated for operation at accelerator grid voltages up to 120 kV, is described. The prototype NBPS has been assembled at the Princeton Plasma Physics Laboratory and operated. The results of the initial operation and the description and resolution of some of the technical problems encountered during the commissioning tests are presented.

8075 **Advanced limiter test (ALT-I) in the TEXTOR tokamak - concept and experimental design.** Conn, R.W.; Grotz, S.P.; Prinja, A.K. (California Univ., Los Angeles (USA). School of Engineering and Applied Science). pp 497-504 of Fusion technology 1982. Proceedings of the 12. symposium held in Juelich, 13-17 September 1982. Vol. 1 of 2 volumes. Oxford, England; Pergamon Press (1983). (CONF-820948—).

From 12. symposium on fusion technology; Juelich, F.R. Germany (13 Sep 1982).

Price Pound 125.00.

The concept and experimental design of a pump-limiter for the TEXTOR tokamak is described. The module is constructed of stainless steel with a compound curvature head designed to limit the maximum heat flux to 300 W/$cm^2$. The head is made of TiC-coated graphite containing a variable aperture slot to admit plasma to a deflector plate for ballistic pumping action. The assembly is actively pumped using Zr-Al getters with an estimated hydrogen pumping speed of 2x$10^4$ l/s. The aspect ratio of the pump duct and the length of the plasma channel are both variable to permit study of plasma plugging, ballistic scattering, and enhanced gas conduction effects. The module can be moved radially by 10 cm to permit its operation either as the primary or secondary limiter. Major diagnostics include Langmuir and solid state probes, bolometers, infrared thermography, thermocouples, ion gauges, manometers, and a gas mass analyzer.

8076 **Graphite limiter and armour damage in Doublet III.** McKelvey, T.; Taylor, T.; Trester, P. (General Atomic Co., San Diego, CA (USA)). pp 511-518 of Fusion technology 1982. Proceedings of the 12. symposium held in Juelich, 13-17 September 1982. Vol. 1 of 2 volumes. Oxford, England; Pergamon Press (1983). (CONF-820948—). Contract AT03-76ET51011;AT03-80SF11512.

From 12. symposium on fusion technology; Juelich, F.R. Germany (13 Sep 1982).

Price Pound 125.00.

Graphite coated with TiC has been used extensively in Doublet III for limiters and neutral beam armour. Performance of these components has been superior to that of the metal components previously used. Damage to the coated graphite has occurred and can be classified into three categories: (1) gross failure of the graphite due to thermal stresses induced by the combination of high applied energy fluxes and mechanical restraint, (2) surface failure of the graphite due to runaway electron impingement, and (3) loss of TiC coating due to arcing, sputtering, vaporization and spalling, primarily during plasma disruptions and other abnormal plasma conditions. Design improvements are being continually implemented to minimize this damage and its consequences.

8077 **Kinetic studies of tritium extraction from neutron irradiated $LiAlO_2$.** Hong, K.C. (Energy Conversion Devices, Inc., Troy, MI (USA)). pp 125-132 of Alternative Energy Sources V. Part E: Nuclear/Conservation/Environment. Proceedings of the fifth Miami International Conference held at Miami Beach, Florida, December 13-15, 1982. Veziroglu, T.N. (Miami Univ., Coral Gables, FL (USA). Clean Energy Research Inst.) (ed.). Amsterdam, Netherlands; Elsevier (1983). (CONF-821213—).

From 5. international conference on alternative energy source; Miami Beach, FL, USA (13 Dec 1982).

The kinetics of tritium extraction from neutron irradiated $LiAlO_2$ powder was studied at 650°C. The experimental results of the particle size effect suggested that tritium extraction from the irradiated $LiAlO_2$ is not just a single step diffusion-controlled process. The results also showed that the longer the sample was exposed to the neutron flux, the slower the tritium extraction rate. Finally, the tritium release rate was independent of the neutron flux rate as long as the sample received the same total amount of neutron dose. 6 figs.; 8 refs.

8078 **Mass spectrometric studies of neutron-irradiated lithium compounds.** Hong, K.C. (Energy Conversion Devices, Inc., Troy, MI (USA)). pp 133-142 of Alternative Energy Sources V. Part E: Nuclear/Conservation/Environment. Proceedings of the fifth Miami International Conference held at Miami Beach, Florida, December 13-15, 1982. Veziroglu, T.N. (Miami Univ., Coral Gables, FL (USA). Clean Energy Research Inst.) (ed.). Amsterdam, Netherlands; Elsevier (1983). (CONF-821213—).

From 5. international conference on alternative energy source; Miami Beach, FL, USA (13 Dec 1982).

The mass spectra of the gases released from neutron-irradiated lithium compounds ($LiAlO_2$, $Li_2Si$, $Li_3Ni$, $Li_2SiO_3$, $Li_7Pb_2$) have been studied. For the oxygen containing materials, tritiated species were found at elevated temperature but not at room temperature. The major tritiated species were $T_2O$. For the oxygen-free lithium compounds, the tritiated species could be detected both at ambient and elevated temperatures. The major species were HTO. The mechanisms of the HTO or $T_2O$ formation were proposed in connection with the tritium extraction kinetics from neutron-irradiated materials. 8 tables; 9 refs.

8079 **Development of tritium technology at the tritium systems test assembly.** Anderson, J.L.; Bartlit, J.R. (Los Alamos National Lab., NM (USA)). pp 527-536 of Fusion technology 1982. Proceedings of the 12. symposium held in Juelich, 13-17 September 1982. Vol. 1 of 2 volumes. Oxford, England; Pergamon Press (1983). (CONF-820948—).

From 12. symposium on fusion technology; Juelich, F.R. Germany (13 Sep 1982).

Price Pound 125.00.

The Tritium Systems Test Assembly (TSTA) at the Los Alamos National Laboratory is dedicated to the development, demonstration, and interfacing of technologies related to the deuterium-tritium fuel cycle for large scale fusion reactor systems starting with the Fusion Engineering Device (FED) or the International Tokamak Reactor (INTOR). A brief description is given of the fuel cycle and safety systems at TSTA including the Vacuum Facility, Fuel Cleanup, Isotope Separation, Transfer Pumping, Emergency Tritium Cleanup, Tritium Waste Treatment, Tritium Monitoring, Data Acquisition and Control, Emergency Power and Gas Analysis systems. Discussed in further detail is the experimental program proposed for the startup and testing of these systems.

# 99 GENERAL AND MISCELLANEOUS

8080 **(CONF-841121—10) 1984 enrollment survey: report to the Department Heads' Forum, AIChE 1984 annual meeting, San Francisco.** Donaldson, T.L. (Oak Ridge National Lab., TN (USA)). 1984. Contract AC05-84OR21400. 6p. NTIS, PC A02. File Number DE85003300.

From AIChE annual meeting; San Francisco, CA, USA (25 Nov 1984).

Data on chemical engineering enrollments at all levels (freshmen-PhD degrees) are summarized for 125 US and 15 Canadian schools. (DLC)

8081 **(LBL-PUB—468) Precollege teachers program at the Lawrence Berkeley Laboratory.** Otto, R.J.; Carlock, P.; Cristancho, S. (Lawrence Berkeley Lab., CA (USA)). Aug 1984. Contract AC03-76SF00098. 33p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85003455.

This report describes the summer science teacher program at the Lawrence Berkeley Laboratory and draws some conclusions regarding its value and effect on the participating teachers.

8082 **(ORAU—230) 1983 faculty and student research participation program evaluation.** Howard, L. (Oak Ridge Associated Universities, Inc., TN (USA)). Sep 1984. Contract AC05-76OR00033. 153p. NTIS, PC A08/MF A01; GPO Dep. File Number DE85003438.

The 1983 Faculty and Student Research Participation Programs provided research opportunities for 55 faculty members and 79 undergraduate students at eleven DOE facilities. The responses to the four surveys conducted with each group indicated that these programs provide rewarding experiences for both the participants and the DOE scientists with whom they worked. However, there were some ways in which the participants and the facility staff felt the program could be made more effective. Primarily, these suggestions were concerned with securing a way for the continuation of the participants' research efforts. In addition, many respondents encouraged both greater and earlier communication among participants, DOE facility staff, and ORAU. Finally, it appears that temporary housing arrangements were not satisfactory in some situations, particularly for participants assigned to DOE facilities in Oak Ridge, Tennessee. These considerations aside, both the participants and the facility staff found the program to be a successful means of providing research experience and an exchange of ideas between the academic world and government research facilities.

8083 **(ORNL/PPA—84/4) Oak Ridge National Laboratory institutional plan FY 1985-FY 1990.** (Oak Ridge National Lab., TN (USA)). Nov 1984. Contract AC05-84OR21400. 121p. NTIS, PC A06/MF A01; GPO Dep. File Number DE85003716.

The primary mission of ORNL is to carry out applied research and engineering in fusion, fission, and other energy technologies, and scientific research in basic physical and life sciences. ORNL designs and provides research facilities. An important part of ORNL's mission is the manufacture and sale of radioactive and stable isotopes that are not available from the private sector. To fulfull its mission, ORNL focuses its scientific and technical efforts on: (1) magnetic fusion, with emphasis on applied plasma physics, experimental and design studies of confinement configurations, development of plasma heating and fueling systems, development of prototype superconducting confinement magnets, and testing of candidate first-wall and blanket materials; (2) nuclear fission, focused on development of nuclear fuel reprocessing, materials test-

ing and development for high-temperature gas-cooled and advanced converter reactors, and technologies for managing nuclear waste; (3) biological and environemental research, with emphasis on interaction of energy-related physical and chemical agents with living organisms; (4) conservation and renewable energy, with emphasis on generic research for high-temperature materials, power systems, biomass production, energy storage, and technology development for buildings and industry; (5) fossil energy, focused on development of materials for fossil fuel applications and on health and environmental effects of coal conversion systems; and (6) basic research in physical sciences, with emphasis in materials research on radiation effects, neutron scattering, and photovoltaic conversion; in chemical science on aqueous solutions; and in nuclear physics on heavy-ion reactions.

8084 **(ORNL/TM—8954) Fossil Energy Materials Program implementation plan for fiscal years 1984 through 1988.** Bradley, R.A.; Carlson, P.T. (comps.). (Oak Ridge National Lab., TN (USA)). Oct 1984. Contract AC05-84OR21400. 199p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE85003817.

This program implementation plan for the Department of Energy Advanced Research and Technology Development (AR & TD) Fossil Energy Materials Program reviews the background, technical issues, and research and development needs for materials of construction for fossil energy systems. The status and plans for research and development activities in the AR & TD Fossil Energy Materials Program are then discussed for various materials disciplines. Detailed information about these plans is provided for FY 1984 through FY 1986, and long-range plans are described for FY 1987 and FY 1988. In addition to descriptions of planned research activities, this plan provides levels of effort required for the various activities.

## 9901 Management

*REFER ALSO TO CITATION(S) 9901006873*

8085 **(ORAU—231) Personnel requirements, education, and training for civilian nuclear activities, 1984-2000.** Stevenson, W. (Oak Ridge Associated Universities, Inc., TN (USA)). Oct 1984. Contract AC05-76OR00033. 192p. NTIS, PC A09/MF A01; GPO Dep. File Number DE85003776.

This report provides projections of the employment of scientists, engineers, technicians, and other occupations for the civilian nuclear industry through the year 2000. Low, medium, and high projections are provided. In all cases, a substantial number of job openings are anticipated to fill needs created by employment growth, retirement, death, and occupational mobility. The expected adequacy of supply to fill these positions is assessed after taking into account projections of college enrollments and degrees along with competing labor demand from nuclear defense, defense waste management, weapons development, non-nuclear defense activities, and other highly technical industries. The likelihood for shortages is high in certain fields. Positions for engineers (particularly nuclear engineers), health physicists, health physics technicians, and electronics technicians will be the most difficult to fill.

8086 **(ORNL/TM—9263) Data and information systems and decision making in large public organizations: research agenda.** Tonn, B.E. (Oak Ridge National Lab., TN (USA)). Nov 1984. Contract AC05-84OR21400. 104p. NTIS, PC A06/MF A01; GPO Dep. File Number DE85003639.

Data management systems and new technology computer systems have transformed our society and in the future will continue to affect change in society. Organizations of every size and type, from large corporations to small businesses, now find their data and information systems indispensable for routine data processing (inventory, pay, and personnel) and decision-support applications. ORNL has initiated a research program that focuses on the use of data and information systems in large public organizations. Within this initiative are opportunities to study problems, ranging from comparing the task performance of competing large-scale and various types of small-scale computers and data systems to designing systems tools to graphically illustrate an organization's information flows. This report has two general purposes: (1) to argue that the tremendous potential of computer-based technology to continue to change our society warants nationwide studies of the relationships between data and information systems and society; and (2) to introduce three research areas (knowledge engineering, decision theory, and policy-modeling) that may yield insights into designing new data and information systems which will improve decision making in large organizations.

## 9902 Mathematics And Computers

*REFER ALSO TO CITATION(S) 9902006455, 6496, 6531, 7255, 7317, 7873*

8087 **(CONF-8410150—1) Software for special functions.** Cody, W.J. (Argonne National Lab., IL (USA)). 20 Sep 1984. Contract W-31-109-ENG-38. 19p. NTIS, PC A02. File Number DE85000069.

From Special functions: theoretical and computational aspects; Torino, Italy (10 Oct 1984).

We have maintained a private index of Bessel function programs for many years, and have frequently used it to respond to users seeking information on such software. This paper expands the index to include software for all sorts of special functions. Thus, we provide a partial answer to the question of availability. The questions of quality and transportability of the software cited are more difficult to answer. We can and do provide general impressions about quality as part of the survy, but complete answers would require that each program mentioned be moved and thoroughly tested. Clearly that task is beyond reason, requiring enormous resources and time. An alternative is to discuss desirable properties of special function software, and ways to determine to what extent the properties exist in a given program. This, of course, leads to a discussion of testing methodology. Each of these topics is too complicated to be discussed fully here. We provide an overview of each to present some of the major considerations and some of the accepted practices. We must rely on citations to more detailed discussions elsewhere to satisfy those who are deeply interested in a topic. Quality and transportability of software take an effort on the part of those writing it; we hope that they, in particular, will find the references useful. Accordingly, Section 2 discusses desirable characteristics of special function software, and the compromises necessary in its preparation. Section 4 lists major sources for special function software and discusses the general characteristics of each collection. Finally, extensive tables in Section 5 and a large bibliography point to much of the software available for the more common special functions. 59 references.

8088 **(LA-UR—84-3068) Influence of the atmosphere on remotely sensed reflection from vegetation surfaces.** Simmer, C.; Gerstl, S.A.W. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 6p. (CONF-850133—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE85000658.

From Optical Society of America topical meeting on optical remote sensing of the atmosphere; Lake Tahoe, NV, USA (15 Jan 1985).

Multiple scattering of solar radiation in a vegetation canopy is modelled equivalent to absorbing and scattering in a turbid medium with direction-dependent cross sections. Perturbations of plant reflection patterns due to atmospheric effects are computed at different altitudes and compared to the angular reflection characteristics caused by Lambertian surfaces of varying albedoes.

8089 **(LA-UR—84-3428) Characterizing the parallelism in rule-based expert systems.** Douglass, R.J. (Los Alamos National Lab., NM (USA)). 1984. Contract W-7405-ENG-36. 19p. (CONF-850131—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85002432.

From International conference on systems science; Honolulu, HI, USA (1 Jan 1985).

A brief review of two classes of rule-based expert systems is presented, followed by a detailed analysis of potential sources of parallelism at the production or rule level, the subrule level (including match, select, and act parallelism), and at the search level (including AND, OR, and stream parallelism). The potential amount

of parallelism from each source is discussed and characterized in terms of its granularity, inherent serial constraints, efficiency, speedup, dynamic behavior, and communication volume, frequency, and topology. Subrule parallelism will yield, at best, two- to tenfold speedup, and rule level parallelism will yield a modest speedup on the order of 5 to 10 times. Rule level can be combined with OR, AND, and stream parallelism in many instances to yield further parallel speedups.

8090 **(UCRL—52000-84-10) Energy and Technology Review.** (Lawrence Livermore National Lab., CA (USA)). Oct 1984. Contract W-7405-ENG-48. 39p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85003245.

This issue features articles on multiprocessing computers, fission and fusion breeder reactors, and supracompression of high-explosive detonation products. Abstracts were prepared separately for each article. (GHT)

8091 (UCRL—52000-84-10, pp 2-11) **Entering the world of multiprocessing.** Oct 1984. NTIS, PC A03/MF A01. File Number TI85003245.

In Energy and Technology Review.

As a direct way to increase the speed of computation, to expand the size of problems it is practical to attempt, and to decrease the real time required to calculate a problem's solution, we are designing software methods that enable many computers to share the work on a single problem. Our new Cray X-MP contains two independent CPUs within the same mainframe, and this number is expected to increase to 16 or more by 1990. Much of our multiuser networking experience is directly applicable to this problem.

8092 **(UCRL—53578) Domain decomposition techniques for solving elliptic partial differential equations on multiprocessors.** Simon, J.H. (Lawrence Livermore National Lab., CA (USA)). May 1984. Contract W-7405-ENG-48. 66p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85004448.

Historically, multiprocessing has long been thought of as an excellent approach for increasing performance. Unfortunately, classical sequential algorithms are not easily translated into parallel algorithms for solving a single problem on several processors. Particularly, solving a matrix problem on a multiprocessor is nontrivial, but successful implementation of matrix iterative algorithms on multiprocessors could significantly increase the performance of the numeric hydrodynamic codes. Therefore, the algorithms must be rewritten to realize the full potential of multiprocessor architectures. This thesis will describe and analyze results from a simulation study of certain matrix iterative methods that could be efficiently implemented on an arbitrary multiprocessor configuration. Chapter one and chapter two present the background matrix theory and notation. Chapter three presents possible splittings for the preconditioned conjugate gradient method and reports numerical results. In addition, this chapter introduces the Schwarz Alternating Principle, the Schwarz numeric iteration, and interesting results for arbitrarily splitting a domain for multiprocessing. Throughout this paper, the Laplace equation with Dirichlet boundary conditions is used as a numerical model for simulation and developing insight into domain decomposition for multiprocessing.

8093 **(UCRL—91253) Sound-graphs: a numerical data analysis method for the blind.** Mansur, D.L.; Blattner, M.M.; Joy, K.I. (Lawrence Livermore National Lab., CA (USA)). Nov 1984. Contract W-7405-ENG-48. 8p. (CONF-850131—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003146.

From International conference on systems science; Honolulu, HI, USA (1 Jan 1985).

A system for the creation of computer generated sound patterns of two dimensional line graphs is described. The objectives of the system are to provide the blind with a means of understanding line graphs in the holistic manner used by those with sight. A continuously-varying pitch is used to represent motion in the x-direction. To test the feasibility of using sound to represent graphs, a prototype system was developed and human factors experiments were performed. Fourteen subjects were used to compare the tactile-graph methods normally used by the blind, to these new sound-graphs. It was discovered that mathematical concepts such as symmetry, monotonicity and the slopes of lines could be determined quickly using sound. Even better performance may be expected with additional training. The flexibility, speed, cost effectiveness and greater measure of independence provided the blind or sight-impaired using these methods was demonstrated.

8094 **(UCRL—91261) Graphics metafile interface to ARAC emergency response models for remote workstation study.** Lawver, B.S. (Lawrence Livermore National Lab., CA (USA)). Oct 1984. Contract W-7405-ENG-48. 4p. (CONF-850108—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85001213.

From SCS multiconference on modeling and simulation; San Diego, CA, USA (24 Jan 1985).

The Department of Energy's Atmospheric Response Advisory Capability models are executed on computers at a central computer center with the output distributed to accident advisors in the field. The output of these atmospheric diffusion models are generated as contoured isopleths of concentrations. When these isopleths are overlayed with local geography, they become a useful tool to the accident site advisor. ARAC has developed a workstation that is located at potential accident sites. The workstation allows the accident advisor to view color plots of the model results, scale those plots and print black and white hardcopy of the model results. This paper will describe the important features of the remote workstation and how those features are supported by the device independent graphics metafile. This work uses a metafile that is very similar to the future ANSI and GKS VDM standard (ANSI X3H3).

8095 **(UCRL—91263) Spatial data requirements for emergency response.** Walker, H. (Lawrence Livermore National Lab., CA (USA)). Oct 1984. Contract W-7405-ENG-48. 6p. (CONF-850108—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85001214.

From SCS multiconference on modeling and simulation; San Diego, CA, USA (24 Jan 1985).

The Atmospheric Release Advisory Capability (ARAC) provides real-time assessments of the consequences resulting from an atmospheric release of radioactive material. In support of this operation, a system has been created which integrates numerical models, data acquisition systems, data analysis techniques, and professional staff. Components of this system rely to large degree on spatial data of various kinds. Of particular importance is the rapid generation of digital terrain models for any area in the continental US. The digital terrain models are used as input to atmospheric models and serve to familiarize assessors to new areas by presenting the terrain surface as a graphical image. In addition, base map data (roads, rivers, political boundaries) must also be supplied as an overlay to ARAC graphical products. A terrain data base and an associated acquisition system have been developed that provide the required terrain data within ten minutes. This terrain data base was derived from the Defense Mapping Agency's planar data. A digital base map data base is currently being developed from the US Geological Survey's 1:2,000,000 Digital Line Graph data as well as their Geographic Names Information System. This base map data base will improve ARAC's response to its mapping needs anywhere in the continental US.

8096 **Error analysis for correlated Monte Carlo data.** Daniell, G.J.; Hey, A.J.G.; Mandula, J.E. (Physics Department, University of Southampton, Southampton SO95NH, United Kingdom). *Physical Review [Section] D: Particles and Fields;* **30**: No. 10, 2230-2232(15 Nov 1984).

The effect of correlations in data from Monte Carlo simulations is discussed and a method for estimating correctly the statistical uncertainty of Monte Carlo averages is presented.

8097 **Multidimensional additive spline approximation.** Friedman, J.H.; Grosse, E.; Stuetzle, W. (Stanford Linear Accelerator Center, CA). *SIAM Journal on Scientific and Statistical Computing;* **4**: No. 2, 291-301(Jun 1983). Contract AC03-76SF00515;AT03-81ER10843.

An adaptive procedure is described that approximates a function of many variables by a sum of (univariate) spline functions s/sub m/ of selected linear combinations a/sub m/ x of the coordinates. The procedure is nonlinear in that not only the spline coefficients but also the linear combinations are optimized for the particular problem. The sample need not lie on a regular grid, and the approximation is affine invarient, smooth, and lends itself to graphical interpretation. Function values, derivatives, and integrals are inexpensive to evaluate.

8098 **Organizing analysis.** Lady, G.M. (Dept. of Energy, Washington, DC). pp 1-16 of Computer-assisted analysis and model simplification. Greenberg, H.J.; Maybee, J.S. (eds.). New York, NY, USA; Academic Press, Inc. (1981). (CONF-8003202—).

From 1. symposium on computer-assisted analysis and model simplification; Boulder, CO, USA (28 Mar 1980).

This paper introduces the Proceedings of a Symposium on Computer-Assisted Analysis and Model Simplification held at the University of Colorado (Boulder). The purposes of this paper are twofold: (1) to give the impressions of the generic issues being addressed, and (2) to contextualize these within the specific concerns of the Energy Information Administration (EIA), US Department of Energy, which is sponsoring the symposium. The scope of the symposium itself, particularly in terms of the several scholarly traditions which bear upon the issues to be considered, is well stated in Greenberg, and associated annotated bibliography, and will not be repeated here.

8099 **Scope of computer-assisted analysis and model simplification.** Greenberg, H.J. (DOE Energy Information Administration, Washington, DC). pp 17-26 of Computer-assisted analysis and model simplification. Greenberg, H.J.; Maybee, J.S. (eds.). New York, NY, USA; Academic Press, Inc. (1981). (CONF-8003202—).

From 1. symposium on computer-assisted analysis and model simplification; Boulder, CO, USA (28 Mar 1980).

This paper describes the scope of computer-assisted analysis, a field recently developed by the author, and its relation to model simplification. It serves as a basis for software under development.

8100 **Qualitative stability of matrices and economic theory: a survey article.** Quirk, J. pp 113-164 of Computer-assisted analysis and model simplification. Greenberg, H.J.; Maybee, J.S. (eds.). New York, NY, USA; Academic Press, Inc. (1981). (CONF-8003202—).

From 1. symposium on computer-assisted analysis and model simplification; Boulder, CO, USA (28 Mar 1980).

A survey is presented of results concerning the stability properties of qualitatively specified matrices, that is, matrices characterized by the sign pattern (+, -, 0) of their entries. Qualitatively specified matrices have been of special importance in the development of certain aspects of economic theory, particularly in comparative statics analysis of both micro and macro models and in the study of the convergence properties of the competitive economy; and economists have contributed to a number of the important developments so far as qualitative stability is concerned. The present survey is restricted to results that have appeared in the literature on economic theory, and to closely related mathematical developments. No attempt has been made to survey the entire literature dealing with qualitative stability in all of its ramifications. However, within the limited scope of the paper, an attempt has been made to identify and summarize the major results that have been obtained over the recent past that relate to qualitative stability of matrices and applications of qualitative stability to economic models.

8101 **Particularizing the generality of economic analysis.** Noble, S.B. pp 271-292 of Computer-assisted analysis and model simplification. Greenberg, H.J.; Maybee, J.S. (eds.). New York, NY, USA; Academic Press, Inc. (1981). (CONF-8003202—).

From 1. symposium on computer-assisted analysis and model simplification; Boulder, CO, USA (28 Mar 1980).

The papers by Lady and O'Neill define the reason for holding a symposium on computer-assisted analysis and model simplification: the computers in EIA of DOE are producing an information glut. The binding constraint has become that of understanding what they provide. These authors give us a thumb-nail history. Up to 1970, the binding constraint had been the ability to compute. As computers improved and became cheaper to operate, the next constraint emerged: the analyst's ability to cope with the information that became available. The solution of this problem, according to Greenberg's position paper, is the mathematics of graph theory which will make it possible to decompose, and hence to simplify, the models. Hence the conference includes papers on graph theory, qualitative stability and sign solvability. The problem is more difficult than has been recognized. Information gluts and understanding are two distinct, although interrelated, problems. Information glut should be handled by computing so as to define significance. Understanding, however, comes from handling a meta-problem: providing an interpretation of a mathematical system. This requires getting outside of the mathematical system by establishing a correspondence between it and reality. Neither significance nor interpretation can be achieved by a mechanical use of graph theory, but when it is seen how to solve these problems, graph theory will be found to play an important role.

## 9903 Information Handling

*REFER ALSO TO CITATION(S) 9903006900*

8102 (INIS-mf—9091, pp 156-158) **Utilization of INIS and AGRIS by the food industry.** Loefflerova, J. (Stredisko Technickych Informaci Potravinarskeho Prumyslu, Prague (Czechoslovakia)). 1982. (In Czech). NTIS (US Sales Only), PC A08/MF A01. File Number TI85780139. (CONF-821288—).

From National seminar on the system of scientific and technical information for the Czechoslovak nuclear programme; Jihlava, Czechoslovakia (7 Dec 1982).

The Technical Information Centre of the Food Industry has begun publishing user handbooks on various foreign services, such as Chemical Abstracts and the CAS, the International Food Information Service - Food Science and Technology Abstracts, the magnetic tape service Engineering Index - COMPENDEX, the DERWENT patent service, a handbook on the services provided by INIS and by AGRIS/FAO.

## 9905 Civilian Defense

8103 **(INIS-mf—9122) Civil Defense Commission of the Federal Minister of the Interior. Conference papers.** (Bundesministerium des Innern, Bonn (Germany, F.R.). Schutzkommission; Bundesamt fuer Zivilschutz, Bonn (Germany, F.R.)). 1983. 233p. (In German). (CONF-8305225—). NTIS (US Sales Only), PC A11/MF A01. File Number DE85780137.

From 32. annual meeting of the Schutzkommission beim Bundesministerium des Innern; Ulm, F.R. Germany (1 May 1983).

Items within the scope of EDB have been entered individually into the data base. (ACR)

8104 **(RAND/N—2070-CC/FF/RC) Preventing nuclear conflict: what can the behavioral sciences contribute.** Kahan, J.P.; Darilek, R.E.; Graubard, M.H.; Brown, N.C. (RAND Corp., Santa Monica, CA (USA)). Dec 1983. 106p. RAND Corp., 1700 Main Street, Santa Monica, CA 90406. File Number TI85900398.

This note addresses one of the most crucial issues of our time, prevention of nuclear war, from the perspective of the behavioral sciences. Both the topic and the perspective are enormously complex subjects in their own right. Consequently, the work presented here represents the conscious honing of a complex problem into a more manageable one: what can the behavioral sciences contribute to the prevention of nuclear conflict between the United States and the Soviet Union.

# CORPORATE AUTHOR INDEX

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Each entry under a corporate heading gives the document title and the volume and abstract numbers. The document type, e.g., R for Report; country of publication, e.g., US; and language of the document, e.g., In German, are given in parentheses at the end of the entry. If no language statement appears, the language is English. Tables of document types and country of publication codes appear after the indexes.

DOE Energy Data Base: Corporate Author Entries (DOE/TIC-4585) is used in the standardization of corporate entries. DOE/TIC-4585 is available for purchase from the National Technical Information Service (NTIS), U. S. Department of Commerce, Springfield, Virginia 22161.

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**Aerospace Corp., Washington, DC (USA)**
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Solar thermal propulsion: an investigation of solar radiation absorption in a working fluid. Final report 9 January-15 April 1984, 10:6607 (R;US)

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Catalyst and reactor development for a liquid phase Fischer-Tropsch process. Quarterly technical progress report, 1 April-30 June 1983, 10:6546 (R;US)

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**Qualifier**
Title, (supplementary information), citation number, (R;US)

The notations in the final parentheses indicate the type of document, e.g., R for Report; the country of publication, e.g., US; and the language if other than English, e.g., In German. Tables of document types and country of publication codes appear after the indexes.

The title may be supplemented with additional words, or a phrase, if it appears additional information would be helpful. In cases for which the title contains little or no information related to the subject entry, it may be replaced entirely by the supplementary information. A qualifier is not always required, and in such cases the title will follow the unqualified subject descriptor.

The descriptors selected for use as subject terms are generally the names of specific materials, things, or processes. To the extent possible, a qualifier is selected to describe the properties of, or processes applied to, the subject term.

Index entries are selected to indicate the important ideas and concepts presented in a document, rather than words that may appear in the text. Within the available thesaurus terms, the most probable or logical place to look for typical information is selected. "See references" are included to guide users from synonymous terms or phrases to the descriptor selected as a subject heading for the concept. (e.g. Pipeline Quality Gas see HIGH BTU GAS). "See also references" are used to indicate where to find references to subject concepts that are narrower, broader, or related to a particular subject heading. To complete an exhaustive search of a given subject, all such headings should be reviewed. Copies of DOE/TIC-7000, the Subject Thesaurus, are available from the National Technical Information Service (NTIS), U. S. Department of Commerce, Springfield, VA 22161.

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| **AC06-76RL01857** | **UNC Nuclear Industries, Inc., Richland, WA (USA). Office of Surplus Facilities Management** | |
| | 10:6534 | RLO/SFM—82-2 |
| **AC06-77RL01030** | **Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations** | |
| | 10:7413 | RHO-RE-SR—84-24-P |
| **AC07-76GJ01664** | **Bendix Field Engineering Corp., Grand Junction, CO (USA)** | |
| | 10:7175 | GJ/TMC—19 |
| **AC07-76ID01570** | **EG and G Idaho, Inc., Idaho Falls (USA)** | |
| | 10:6271 | EGG-M—25783 |
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| | **Idaho National Engineering Lab., Idaho Falls (USA)** | |
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| | 10:7537 | EGG-M—17384 |
| | 10:7538 | EGG-M—18184 |
| **AC07-83ID12427** | **Thermal Energy Storage, Inc., San Diego, CA (USA)** | |
| | 10:6890 | DOE/ID/12427—T1 |
| **AC07-84ID12435** | **Westinghouse Idaho Nuclear Co., Inc., Idaho Falls (USA)** | |
| | 10:7382 | NUREG/CR—4014 |
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| **AC08-80DP40124** | **Rochester Univ., NY (USA). Lab. for Laser Energetics** | |
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| **AC08-82DP40152** | **KMS Fusion Inc., Ann Arbor, MI** | |
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| | 10:6470 | DOE/NV/10250—16 |
| **AC09-76SR00001** | **Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.** | |
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| | 10:7414 | DP-MS—84-99 |
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| **AC18-80FC10159** | **Bituminous Coal Research, Inc., Monroeville, PA (USA). National Lab.** | |
| | 10:6293 | DOE/FC/10159—1 |
| **AC19-80BC10327** | **INTERCOMP Resource Development and Engineering, Inc., Houston, TX (USA)** | |
| | 10:6360 | DOE/BC/10327—21 |
| **AC21-76ET12138** | **West Virginia Univ., Morgantown (USA). Dept. of Chemical Engineering** | |
| | 10:6256 | DOE/ET/12138—1388 |
| **AC21-82MC19301** | **Institute of Gas Technology, Chicago, IL (USA)** | |
| | 10:6259 | DOE/MC/19301—4 |
| **AC21-83FE60338** | **United Technologies Corp., South Windsor, CT (USA). Power Systems Div.** | |
| | 10:6964 | DOE/FE/60338—T5 |
| **AC21-83MC20334** | **Massachusetts Inst. of Tech., Cambridge (USA)** | |
| | 10:7305 | DOE/MC/20334—T13 |
| **AC22-78ET11423** | **SRI International, Menlo Park, CA (USA)** | |
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| | **SRI International, Menlo Park, CA (USA). Chemistry Lab.** | |
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| | 10:6290 | DOE/ET/11423—T11 |
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| **AC22-79ET14804** | **C-E Lummus, Bloomfield, NJ (USA)** | |
| | 10:6257 | DOE/ET/14804—T4 |
| **AC22-79ET14809** | **Brigham Young Univ., Provo, UT (USA)** | |
| | 10:6545 | DOE/ET/14809—13 |

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| AC22-80PC30021 | Air Products and Chemicals, Inc., Allentown, PA (USA) | |
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| AC22-80PC30027 | Conoco, Inc., Library, PA (USA). Coal Research Div. | |
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| AC22-80PC30304 | Aerochem Research Labs., Inc., Princeton, NJ | |
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| AC22-82FE60088 | Avco-Everett Research Lab., Inc., Everett, MA (USA) | |
| | 10:6306 | DOE/FE/60088—T3 |
| AC22-83PC60015 | Wyoming Univ., Laramie (USA). Office of Univ. Research | |
| | 10:6294 | DOE/PC/60015—18 |
| AC22-83PC60265 | Science Applications, Inc., San Diego, CA (USA) | |
| | 10:6309 | DOE/PC/60265—T5 |
| AC22-83PC60409 | Science Applications, Inc., La Jolla, CA (USA) | |
| | 10:6310 | DOE/PC/60409—T3-Vol.2 |
| | 10:6311 | DOE/PC/60409—T3-Vol.3 |
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| AI01-76ET20320 | Ohio State Univ., Columbus (USA) | |
| | 10:6730 | DOE/NASA—0330-1 |
| AI01-76ET20356 | Jet Propulsion Lab., Pasadena, CA (USA) | |
| | 10:6569 | DOE/JPL/1012—99 |
| AI01-76PR06010 | National Bureau of Standards, Washington, DC (USA). Center for Fire Research | |
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| | National Engineering Lab. (NBS), Washington, DC (USA) | |
| | 10:6655 | NBSIR—84-2942 |
| | Colorado State Univ., Fort Collins (USA). Dept. of Mechanical Engineering | |
| | 10:6991 | NBSIR—84-2906 |
| AI01-78CS54209 | Jet Propulsion Lab., Pasadena, CA (USA) | |
| | 10:7068 | DOE/CS/54209—15 |
| AI01-78ER06484 | Naval Research Lab., Washington, DC (USA). Optical Sciences Div. | |
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| | 10:7061 | DOE/NASA/50194—41 |
| AI01-81FE15034 | Tennessee Valley Authority, Chattanooga (USA). Div. of Energy Demonstrations and Technology | |
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| AI05-84ER13150 | National Bureau of Standards, Washington, DC (USA). Center for Chemical Physics | |
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| AI07-81ID12306 | Geological Survey, Idaho Falls, ID (USA) | |
| | 10:6468 | DOE/ID—22067 |
| AI08-78ET44802 | Geological Survey, Denver, CO (USA) | |
| | 10:6506 | USGS-OFR—84-449 |
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| | Fenix and Scisson, Inc., Mercury, NV (USA) | |
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| AI21-80ET17088 | Clarkson Coll. of Tech., Potsdam, NY (USA) | |
| | 10:6965 | DOE/NASA—0238-1 |
| AM01-76EI02295 | Massachusetts Inst. of Tech., Cambridge (USA). Lab. of Architecture and Planning | |
| | 10:7418 | DOE/EI/02295—T5 |
| AM03-76SF00115 | SRI International, Menlo Park, CA (USA) | |
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| AS05-76CS34976 | Maryland Univ., College Park (USA). Dept. of Mechanical Engineering | |
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| AS05-76ER04310 | Smithsonian Institution, Rockville, MD (USA). Smithsonian Environmental Research Center | |
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| AS05-76ER05096 | Rice Univ., Houston, TX (USA). Bonner Nuclear Labs. | |
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| AS05-76ER05223 | Department of Physics, Texas A&M University, College Station, Texas 77843 | |
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| AS05-76ER05246 | Georgia Inst. of Tech., Atlanta (USA). Engineering Experiment Station | |
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| AS05-78EV05855 | Florida State Univ., Tallahassee | |
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| AS05-79ER10348 | Tennessee Univ., Knoxville (USA). Dept. of Physics and Astronomy | |
| | 10:7082 | DOE/ER/10348—6 |
| AS05-80ER10713 | Physics Department, Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061 | |
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| AS05-81ER10936 | Ames Lab., IA (USA) | |
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| | Kentucky Univ., Lexington (USA). Dept. of Physics and Astronomy | |
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| | California Univ., San Diego, La Jolla (USA). Dept. of Physics | |
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| AS05-81ER10946 | Univ. of Houston, TX | |
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| AS05-84ER13145 | Maryland Univ., College Park (USA) | |
| | 10:7901 | DOE/ER/13145—T1 |

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| AS08-82DP40175 | Hawaii Univ., Honolulu (USA). Dept. of Physics and Astronomy | |
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| AS09-77ER01023 | Univ. of Georgia, Athens | |
| | 10:6543 | Separation Science and Technology 18 NO. 12-13. 1275-1294 (1983). |
| AS20-81LC10713 | Texas Univ., Austin (USA) | |
| | 10:6258 | DOE/LC/10713—1663 |
| AT01-80RA50241 | National Bureau of Standards, Boulder, CO (USA). Chemical Engineering Science Div. | |
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| AT03-76ET51011 | GA Technologies, Inc., San Diego, California 92138 | |
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| | GA Technologies, Inc., San Diego, CA (USA) | |
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| AT03-76ET53060 | California Inst. of Tech., Pasadena (USA) | |
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| AT03-77ER71128 | SRI International, Menlo Park, CA (USA) | |
| | 10:7085 | DOE/ER/71128—T1 |
| AT03-81ER10867 | Stanford Univ., CA (USA). Dept. of Civil Engineering | |
| | 10:7277 | DOE/ER/10867—T1 |
| AT03-82ER12023 | GA Technologies, Inc., San Diego, CA (USA) | |
| | 10:7042 | GA-A—17779 |
| AT03-84ER52104 | California Univ., Los Angeles (USA). Center for Plasma Physics and Fusion Engineering | |
| | 10:8063 | UCLA-ENG—8437 |
| AT06-77EV70029 | Oregon State Univ., Corvallis (USA). Dept. of Oceanography | |
| | 10:7543 | DOE/EV/70029—T1 |
| AT06-81ER10912 | Washington Univ., Seattle (USA). Dept. of Chemistry | |
| | 10:7157 | DOE/ER/10912—T2 |
| AT21-77MC08711 | West Virginia Univ., Morgantown (USA). Medical Center | |
| | 10:7508 | DOE/MC/08711—T1 |
| FC02-80CS30343 | North Design, Madison, WI (USA) | |
| | 10:6612 | DOE/CS/30343—T1 |
| FC02-80ET20642 | United Technologies Research Center, East Hartford, CT (USA) | |
| | 10:6615 | DOE/ET/20642—T1 |
| FC03-77SF10501 | Southern California Edison Co., Los Angeles (USA) | |
| | 10:6597 | DOE/SF/10501—061 |
| | Southern California Edison Co., Rosemead (USA) | |
| | 10:6895 | DOE/SF/10501—015 |
| FC04-80CS30599 | Acurex Solar Corp., Mountain View, CA (USA) | |
| | 10:6636 | DOE/CS/30599—T2 |
| FG01-78CS54262 | SCORE, Inc., Cambridge, MA (USA) | |
| | 10:7034 | DOE/CS/54262—T1 |
| FG01-79CS20097 | Los Angeles County Sanitation Districts, Whittier, CA (USA) | |
| | 10:7054 | DOE/CS/20097—T1 |
| FG01-79RG10237 | Alabama Office of the Attorney General, Montgomery (USA) | |
| | 10:6956 | DOE/RG/10237—T1 |
| FG01-80EI10357 | Pennsylvania Governor's Energy Council, Harrisburg (USA) | |
| | 10:6387 | DOE/EI/10357—T1 |
| FG01-81AD11256 | Alabama A and M Univ., Normal (USA). Dept. of Economics | |
| | 10:7419 | DOE/AD/11256—T1 |
| FG02-77CS30393 | Western Solar Utilization Network, Portland, OR (USA) | |
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| FG02-80CS83101 | Michigan State Univ., East Lansing | |
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| FG03-84ER53173 | California Inst. of Tech., Pasadena (USA) | |
| | 10:7926 | DOE/ER/53173—T1 |
| FG07-83ID12437 | Council of State Governments, Chicago, IL (USA) | |
| | 10:6469 | DOE/ID/12437—1 |
| FG07-83ID12478 | Balzhiser/Hubbard and Associates, Eugene, OR (USA) | |
| | 10:6725 | DOE/ID/12478—T6 |
| FG18-79ET14690 | Maine Dept. of Conservation, Augusta (USA). Maine Geological Survey | |
| | 10:6331 | DOE/ET/14690—T2-Vol.1 |
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| | 10:6334 | DOE/ET/14690—T2-Vol.4 |
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| FG19-78ET12236 | Missouri Univ., Rolla (USA). Dept. of Mechanical Engineering | |
| | 10:7060 | DOE/ET/12236—1 |
| FG22-78ET12162 | University of Southern California, Los Angeles (USA). School of Engineering | |
| | 10:6292 | DOE/ET/12162—T1 |
| FG22-81PC40771 | Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Chemical Engineering | |
| | 10:6547 | DOE/PC/40771—14 |
| FG22-81PC40801 | Texas Univ., Austin (USA). Dept. of Chemical Engineering | |
| | 10:6263 | DOE/PC/40801—T6 |
| FG22-81PC40802 | Lehigh Univ., Bethlehem, PA (USA). Center for Surface and Coatings Research | |
| | 10:6348 | DOE/PC/40802—T1 |
| FG22-81PC40806 | Washington State Univ., Pullman (USA). Nuclear Radiation Center | |
| | 10:6308 | DOE/PC/40806—7 |
| FG22-82PC50266 | Carnegie-Mellon Univ., Pittsburgh, PA (USA). Dept. of Mechanical Engineering | |
| | 10:6349 | DOE/PC/50266—7 |
| FG22-82PC50799 | Delaware Univ., Newark (USA). Dept. of Chemical Engineering | |
| | 10:6264 | DOE/PC/50799—T4 |
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| FG22-82PC50807 | Duke Univ., Durham, NC | |
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| FG22-83PC60054 | Pittsburgh Univ., PA (USA). Dept. of Chemical and Petroleum Engineering | |
| | 10:6266 | DOE/PC/60054—T4 |
| FG22-83PC60785 | Kentucky Univ., Lexington (USA) | |
| | 10:6268 | DOE/PC/60785—5 |
| FG22-83PC60795 | Northwestern Univ., Chicago, IL (USA). Dept. of Chemistry | |
| | 10:6548 | DOE/PC/60795—4 |
| FG22-83PC60801 | California Inst. of Tech., Pasadena (USA) | |
| | 10:6347 | CONF-841121—11 |
| FG22-83PC60807 | Brigham Young Univ., Provo, UT (USA) | |
| | 10:6295 | DOE/PC/60807—5 |
| FG22-83PC60808 | North Dakota Univ., Grand Forks (USA) | |
| | 10:6269 | DOE/PC/60808—3 |
| FG22-83PC61252 | Michigan Univ., Ann Arbor (USA). Dept. of Atmospheric and Oceanic Science | |
| | 10:7372 | DOE/PC/61252—T1 |
| FG22-84PC70006 | Colorado School of Mines, Golden (USA). Dept. of Chemical and Petroleum Refining Engineering | |
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| **FG22-84PC70805** | **Pennsylvania State Univ., University Park (USA). Coll. of Earth and Mineral Sciences** | |
| | 10:6341 | DOE/PC/70805—T1 |
| **FG22-84PC71503** | **Pittsburgh Univ., PA (USA)** | |
| | 10:6342 | DOE/PC/71503—T1 |
| **FG44-80R410227** | **Withers (John D., Jr.), Woodville, MS (USA)** | |
| | 10:6616 | DOE/R4/10227—T1 |
| **FG44-81R410463** | **Burch (Jefferson B.), Oakland, FL (USA)** | |
| | 10:6617 | DOE/R4/10463—T1 |
| **W-31-109-ENG-38** | **Argonne National Lab., IL (USA)** | |
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| | **Argonne National Lab., IL (USA)** | |
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| | *See* KEK-82-8 | DE85780011 | MN -34C | 10:7611 |
| CONF-8203195- | (Information meeting on the research and development project on ventilation in housing, Juelich, F.R. Germany, 25 Mar 1982) | | | |
| | NTIS (US Sales Only), PC A07/MF A01; 1 | DE85770075 | MN -95d | 10:6972 |
| CONF-820582- | (24. COSPAR meeting (Committee on Space Research), Ottawa, Canada, 17 May-2 Jun 1982) | | | |
| | Adv. Space Res., 3: 73-78(1983) | | | 10:7496 |
| | Adv. Space Res., 3: 161-170(1983) | | | 10:7497 |
| | Adv. Space Res., 3: 211-219(1983) | | | 10:7498 |
| CONF-8205180- | (6. scientific conference on power economy, Zittau, German D.R., 11-13 May 1982) | | | |
| Pt.2 | *See* IHZ-WK-81-380 | DE85780209 | MN -78 | 10:6747 |
| CONF-8208184- | (Symposium on impact of world atmospheric modification on plant growth and productivity, Ames, IA, USA, 11 Aug 1982) | | | |
| | HortScience, 18: No. 5, 684-689(Oct 1983) | | | 10:7513 |
| CONF-8209259- | (ESNA working group on waste heat utilization, Brno, Czechoslovakia, 6-11 Sep 1982) | | | |
| | *See* INIS-mf-9092 | DE85780146 | MN -2 | 10:7043 |

| *Report Number* | *Availability Source* | *File Number* | *Distribution Category* | *Abstract Number* |
|---|---|---|---|---|
| CONF-8209261- | (CNS/ANS Taiwan Section topical meeting on nuclear fuel cycle technology, Taipei, Taiwan, 29-30 Sep 1982) | | | |
| 1 | *See* INER-0474 | DE85900137 | MN -78 | 10:6785 |
| CONF-8210286- | (35. American Ceramic Society annual Pacific Coast Regional meeting, Seattle, WA, USA, 27 Oct 1982) | | | |
| | J. Am. Ceram. Soc., 66: No. 7, C111-C113(Jul 1983) | | | 10:7149 |
| CONF-8210310- | (Crack detection meeting, Olomouc, Czechoslovakia, 11 Oct 1928,-14 Oct 1982) | | | |
| | *See* INIS-mf-9093 | DE85780142 | MN -25 | 10:7289 |
| CONF-8211193- | (Fuelwood management and utilization seminar, East Lansing, MI, USA, 9-11 Nov 1982) | | | |
| | NTIS, PC A09/MF A01; 1 (GPO Dep.) | DE85000687 | MN -61 | 10:6567 |
| CONF-8211198- | (Workshop on transitional processes, Ottawa, Canada, 5 Nov 1982, 5 Nov 1982) | | | |
| | *See* AECL-7822 | TI84901541 | ND -70 | 10:6464 |
| CONF-821288- | (National seminar on the system of scientific and technical information for the Czechoslovak nuclear programme, Jihlava, Czechoslovakia, 7-9 Dec 1982) | | | |
| | *See* INIS-mf-9091 | DE85780139 | MN -23 | 10:7888 |
| CONF-8304144- | (23. conference on nuclear spectroscopy and nuclear structure, Moscow, USSR, 19-21 Apr 1983) | | | |
| 1 | *See* JINR-R-6-83-518 | DE84703232 | MN -34C | 10:7842 |
| CONF-8305220- | (2. CSNI specialists meeting on probabilistic methods in seismic risk assessment for nuclear power plants, Livermore, CA, USA, 16-18 May 1983) | | | |
| | NTIS, PC A20/MF A01; 1 (GPO Dep.) | DE85003234 | MN -11 | 10:6821 |
| CONF-8305225- | (32. annual meeting of the Schutzkommission beim Bundesministerium des Innern, Ulm, F.R. Germany, 1 May 1983) | | | |
| | *See* INIS-mf-9122 | DE85780137 | MN -48 | 10:8103 |
| CONF-8305231- | (Austrian mining day '83 meeting, Leoben, Austria, 3-5 May 1983) | | | |
| Absts. | NTIS (US Sales Only), PC A02/MF A01; 1 | DE85770095 | MN -88 | 10:6338 |
| CONF-830610- | (Nevada Applied Ecology Group transuranics (and associated radionuclides) information conference, Las Vegas, NV, USA, 28-30 Jun 1983) | | | |
| 6 | *See* UCRL-91781 | DE85003451 | MN -41 | 10:7397 |
| CONF-830617- | (76. annual meeting of the Air Pollution Control Association, Atlanta, GA, USA, 19-24 Jun 1983) | | | |
| 16 | *See* BNL-35223 | DE85003604 | MN -11 | 10:7369 |
| CONF-8306168- | (17. annual meeting of Fachverband fuer Strahlenschutz e.V., Aachen, F.R. Germany, 8-10 Jun 1983) | | | |
| | *See* FS-83-32-T | | | 10:7875 |
| CONF-8306235- | (Eurochemic experience, Mol, Belgium, 9-11 Jun 1983) | | | |
| | *See* ETR-318 | DE85780073 | MN -86 | 10:6442 |
| CONF-8307145- | (Workshop on relaxation in disordered systems, Blacksburg, VA, USA, 1 Jul 1983) | | | |
| 1 | *See* LA-UR-84-3497 | DE85003743 | MN -25 | 10:7098 |
| CONF-8309306- | (Geochemistry of high-level waste disposal in granitic rocks workshop, Oxford, UK, 12-16 Sep 1983) | | | |
| | *See* AECL-8361 | TI84901833 | ND -70 | 10:6465 |
| CONF-8310298- | (ASLE and ASME lubrication conference, Hartford, CT, USA, 18 Oct 1983) | | | |
| | Am. Soc. Mech. Eng., [Pap.], No. 83-Lub-19, 1-8(1984) | | | 10:7270 |
| CONF-8310334- | (69. national congress of Italian Physical Society, Messina, Italy, 21-26 Oct 1983) | | | |
| 1 | *See* INFN/BE-83-8 | DE85700147 | MN -34C | 10:7832 |
| CONF-831174- | (Materials Research Society annual meeting, Boston, MA, USA, 14-17 Nov 1983) | | | |
| | Elsevier Science Publishing Co., 52 Vanderbilt Ave., New York, NY 10017 | TI84014304 | ND -70 | 10:6513 |
| CONF-8311215- | (Conference on the Deutsches Atomforum e.V.: on the present state of nuclear industry in France, Bonn, F.R. Germany, 28 Nov 1983) | | | |
| | *See* INIS-mf-9163 | DE85780182 | MN -2 | 10:6787 |
| CONF-831244- | (2. conference on management of municipal, hazardous, and coal wastes, Miami Beach, FL, USA, 5-7 Dec 1983) | | | |
| | *See* DOE/METC-84-34 | DE85001957 | STD -90i | 10:6307 |
| CONF-831297- | (Seminar on comblustion engines, Karlsruhe, F.R. Germany, 13 Dec 1983) | | | |
| 1 | NTIS (US Sales Only), PC A02/MF A01; 1 | DE85770092 | MN -96 | 10:7057 |
| CONF-840182- | (Commercial refrigeration research workshop, Palo Alto, CA, USA, 12-13 Jan 1984) | | | |
| Summ. | *See* EPRI-EM-3699 | TI85920150 | ND -95f | 10:6986 |
| CONF-840218- | (113. annual meeting of the American Institute of Mining, Metallurgical and Petroleum Engineers, Los Angeles, CA, USA, 26 Feb-2 Mar 1984) | | | |
| | Prepr., Soc. Min. Eng. AIME, 84-50: 14(Feb 1984) | | | 10:6509 |
| | Prepr., Soc. Min. Eng. AIME, 84-162: 13(Feb 1984) | | | 10:6761 |

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|---|---|---|---|---|
| CONF-840264- | (Workshop on high energy excitations in condensed matter, Los Alamos, NM, USA, 13-15 Feb 1984) | | | |
| 7 | *See* RAL-84-020 | DE84703194 | MN -34A | 10:7872 |
| CONF-840280- | (Recontre de Moriond meeting on electro weal interactions and unified theories, La Plaque, France, 26 Feb-4 Mar 1984) | | | |
| 10 | *See* KFK-3758 | DE84752338 | MN -34D | 10:7612 |
| CONF-840383- | (12. symposium on explosives and pyrotechnics, San Diego, CA, USA, 13-15 Mar 1984) | | | |
| 2 | *See* LA-UR-84-392 | DE84009611 | MN -45 | 10:7299 |
| CONF-8403121- | (New particle production at high energy meeting: The Recontre de Moriond, La Plagne, France, 4-10 Mar 1984) | | | |
| 10 | *See* DESY-84-039 | DE84752298 | MN -34D | 10:7605 |
| CONF-8403156- | (MINTEK 50: international conference on recent advances in mineral science and technology, Sandton, South Africa, 26-30 Mar 1984) | | | |
| Absts. | *See* INIS-mf-9098 | DE85780156 | MN -20 | 10:7071 |
| CONF-8403158- | (1. seminar on nondestructive evaluation of ferromagnetic materials, Houston, TX, USA, 1 Mar 1984) | | | |
| 1 | *See* IS-M-528 | DE85003081 | MN -25 | 10:7291 |
| CONF-840405- | (NACE corrosion '84 international forum and exhibition, New Orleans, LA, USA, 1-6 Apr 1984) | | | |
| 14 | *See* UCRL-89988 | DE85003567 | MN -70 | 10:7109 |
| CONF-840459- | (29. national SAMPE symposium, Reno, NV, USA, 3-5 Apr 1984) | | | |
| 6 | *See* UCRL-90195 | DE85003611 | MN -25 | 10:7155 |
| CONF-840463- | (6. annual energy seminar, Erie, PA, USA, 3-4 Apr 1984) | | | |
| 1 | *See* SLAC-PUB-3421 | DE85002719 | MN -34D | 10:7616 |
| CONF-840489- | (Gas-liquid chemistry of natural waters conference, Upton, NY, USA, 1-6 Apr 1984) | | | |
| Vol.1-Summs. | *See* BNL-51757-Vol.1 | DE85002603 | STD -11 | 10:7399 |
| Vol.2-Summs. | *See* BNL-51757-Vol.2 | DE85002457 | STD -11 | 10:7400 |
| CONF-8404112- | (Acid rain--a New York State agenda, Albany, NY, USA, 10-11 Apr 1984) | | | |
| 1 | *See* BNL-35030 | DE85003605 | MN -11 | 10:7368 |
| CONF-8404131- | (Scanning electron microscopy conference, Philadelphia, PA, USA, 15-20 Apr 1984) | | | |
| 2 | *See* BNL-35338 | DE85003606 | MN -4 | 10:7173 |
| CONF-8404195- | (Training course on radiation protection, Balatonkenese, Hungary, 11-13 Apr 1984) | | | |
| Summ. | *See* INIS-mf-9071 | DE85780132 | MN -4 | 10:7485 |
| CONF-8405120- | (SPE/DOE/GRI unconventional gas recovery symposium, Pittsburgh, PA, USA, 13-15 May 1984) | | | |
| | Soc. Pet. Eng. AIME, Pap., SPE/DOE/GRI 12850: 201-208(May 1984) | | | 10:6357 |
| | Soc. Pet. Eng. AIME, Pap., SPE/DOE/GRI 12881: 471-482(May 1984) | | | 10:6384 |
| CONF-8405155- | (Inner space/outer space conference, Batavia, IL, USA, 2-5 May 1984) | | | |
| 5 | *See* SLAC-PUB-3373 | DE85002720 | MN -34D | 10:7663 |
| CONF-8405179- | (International conference on theoretical approaches to heavy ion reaction mechanisms, Paris, France, 14-18 May 1984) | | | |
| 4 | *See* GSI-84-32-Prepr. | DE84752292 | MN -34D | 10:7830 |
| CONF-8405200- | (18. annual Pacific Northwest Regional Economic conference, Olympia, WA, USA, 3-5 May 1984) | | | |
| 2 | *See* PNL-SA-12246 | DE85003106 | MN -97 | 10:6957 |
| CONF-8405233- | (1. European telemetry conference (ETC'84) and 7. national conference and exhibition of the Arbeitskreis Telemetria e.V., Boeblingen, F.R. Germany, 21-24 May 1984) | | | |
| 1 | *See* Juel-1909 | DE84752302 | MN -20 | 10:7979 |
| CONF-8405253- | (State workshop on shallow land burial and alternative disposal concepts, Bethesda, MD, USA, 2-3 May 1984) | | | |
| | *See* NUREG/CP-0055 | TI85900384 | MN -70B | 10:6489 |
| CONF-840604- | (12. international symposium on effects of radiation on materials, Williamsburg, VA, USA, 18-20 Jun 1984) | | | |
| 30 | *See* DOE/ER/10107-24 | DE85003668 | MN -20c | 10:7081 |
| CONF-840647- | (ASME pressure vessel and piping conference, San Antonio, TX, USA, 17-21 Jun 1984) | | | |
| | Am. Soc. Mech. Eng., [Pap.], 84-PVP-22: 8(Jun 1984) | | | 10:6791 |
| | Am. Soc. Mech. Eng., [Pap.], 84-PVP-55: 10(Jun 1984) | | | 10:6792 |
| | Am. Soc. Mech. Eng., [Pap.], 84-PVP-23: 6(Jun 1984) | | | 10:6793 |
| | Am. Soc. Mech. Eng., [Pap.], 84-PVP-26: 6(Jun 1984) | | | 10:7116 |
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| | Am. Soc. Mech. Eng., [Pap.], 84-PVP-126: 10(Jun 1984) | | | 10:7118 |
| | Am. Soc. Mech. Eng., [Pap.], 84-PVP-106: 9(Jun 1984) | | | 10:7119 |
| | Am. Soc. Mech. Eng., [Pap.], 84-PVP-57: 11(Jun 1984) | | | 10:7120 |
| CONF-8406149- | (TRIUMF-ISOL workshop, Montreal, Canada, 13-15 Jun 1984) | | | |
| 4 | *See* PNL-SA-12343 | DE85003105 | MN -22 | 10:7792 |
| CONF-8406150- | (Symposium on the achievements of IMS, Graz, Austria, 26-28 Jun 1984) | | | |
| 2 | *See* LA-UR-84-3330 | DE85002414 | MN -34B | 10:7560 |
| CONF-8406183- | (15. international symposium on multiparticle dynamics, Lund, Sweden, 11-16 Jun 1984) | | | |
| 6 | *See* LBL-18424 | DE85000597 | MN -34D | 10:7613 |
| CONF-8406198- | (Design and utilization of the superconducting super collider summer study, Snowmass, CO, USA, 23 Jun-13 Jul 1984) | | | |
| 16 | *See* SLAC-PUB-3456 | DE85002606 | MN -34D | 10:7618 |
| 21 | *See* BNL-35378 | DE85003214 | MN -34D | 10:7602 |
| 22 | *See* BNL-35244 | DE85003223 | MN -28 | 10:7313 |
| 23 | *See* LBL-18402 | DE85003470 | MN -28 | 10:7662 |
| CONF-8406222- | (Annual international conference of the Western Economic Association, Las Vegas, NV, USA, 24-28 Jun 1984) | | | |
| 1 | *See* PNL-SA-12246 | DE85003106 | MN -97 | 10:6957 |
| CONF-8406224- | (Symposium on state of the art feedwater heater technology, Washington, DC, USA, 5-7 Jun 1984) | | | |
| | *See* EPRI-CS/NP-3743 | TI85920123 | ND -38 | 10:6734 |
| CONF-840705- | (10. international conference on cryogenic engineering, Espoo, Finland, 31 Jul-3 Aug 1984) | | | |
| 5 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | DE85002731 | MN -38 | 10:7257 |
| CONF-840738- | (Progress in quantitative NDE, San Diego, CA, USA, 8-13 Jul 1984) | | | |
| 12 | *See* UCRL-90716 | DE85003147 | MN -38 | 10:7267 |
| CONF-840757- | (22. international conference on high energy physics, Leipzig, German D.R., 19-25 Jul 1984) | | | |
| 8 | *See* ANL-HEP-CP-84-22 | DE84016895 | MN -34C | 10:7601 |
| CONF-840760- | (Ion beam modification of materials conference, Ithaca, NY, USA, 16-20 Jul 1984) | | | |
| 16 | *See* PNL-SA-12097 | DE85003114 | MN -25 | 10:7105 |
| CONF-840789- | (International conference on particles and nuclei, Heidelberg, F.R. Germany, 30 Jul-3 Aug 1984) | | | |
| 5 | *See* SLAC-PUB-3434 | DE85002718 | MN -34D | 10:7617 |
| CONF-8407104- | (Gordon conference, Tilton, NH, USA, 9-13 Jul 1984) | | | |
| 1 | *See* BNL-35177 | DE85001928 | MN -34D | 10:7659 |
| 2 | *See* BNL-34938 | DE85003204 | MN -34C | 10:7321 |
| CONF-840816- | (22. national heat transfer conference, Niagara Falls, NY, USA, 5-8 Aug 1984) | | | |
| 23 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | DE85003044 | MN -78 | 10:6818 |
| 24 | *See* SERI/TP-252-2295 | DE85000528 | MN -62 | 10:6646 |
| CONF-840855- | (International conference on energy modelling and simulation, Minneapolis, MN, USA, 13-17 Aug 1984) | | | |
| 1 | *See* BNL-35384 | DE85003517 | MN -32 | 10:7919 |
| CONF-8408126- | (American Phychological Association meeting, Toronto, Canada, 24-28 Aug 1984) | | | |
| 2 | *See* PNL-SA-12010 | DE85003644 | MN -41 | 10:6873 |
| CONF-8408127- | (NATO advanced study institute on supersymmetry, Bonn, F.R. Germany, 20-31 Aug 1984) | | | |
| 1 | *See* SLAC-PUB-3461 | DE85002607 | MN -34D | 10:7664 |
| CONF-8408129- | (Conference on the quark structure of matter, Scarborough, Ontario, Canada, 11-25 Aug 1984) | | | |
| 1 | NTIS, PC A03/MF A01 (GPO Dep.) | DE85002724 | MN -34D | 10:7667 |
| CONF-840901- | (ANS topical meeting on reactor physics and shielding, Chicago, IL, USA, 17-19 Sep 1984) | | | |
| 18 | *See* HEDL-SA-3107-FP | DE85000296 | MN -79 | 10:6803 |
| 21 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | DE85002743 | MN -79e | 10:6768 |
| CONF-840902- | (5. ASTM-Euratom symposium on reactor dosimetry, Geesthacht, F.R. Germany, 24-28 Sep 1984) | | | |
| 12 | *See* HEDL-SA-3064A | DE85001496 | MN -80 | 10:6790 |
| 13 | *See* HEDL-SA-3063A | DE85000292 | MN -78 | 10:6755 |
| 15 | *See* HEDL-SA-3102 | DE85001202 | MN -78 | 10:6802 |
| CONF-840906- | (Capture gamma-ray spectroscopy conference, Knoxville, TN, USA, 10-14 Sep 1984) | | | |
| 14 | NTIS, PC A02/MF A01 (GPO Dep.) | DE85003543 | MN -34C | 10:7759 |
| 15 | *See* BNL-35319 | DE85003206 | MN -34D | 10:7798 |
| 16 | *See* BNL-35325 | DE85003215 | MN -34C | 10:7829 |
| 17 | *See* BNL-35336 | DE85003211 | MN -34C | 10:7742 |
| 18 | *See* BNL-35342 | DE85003603 | MN -34D | 10:7719 |
| CONF-840914- | (International meeting on thermal nuclear reactor safety, Karlsruhe, F.R. Germany, 10-14 Sep 1984) | | | |
| 17 | *See* BNL-NUREG-35180 | TI85000589 | MN -77 | 10:6814 |

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|---|---|---|---|---|
| CONF-840937- | (Applied superconductivity conference, San Diego, CA, USA, 9-13 Sep 1984) | | | |
| 21 | *See* BNL-35373 | DE85003212 | MN -25 | 10:7074 |
| CONF-840963- | (DOE and DOE contractors' occupational safety and health conference, San Diego, CA, USA, 11-13 Sep 1984) | | | |
| 5 | *See* EGG-M-16684 | DE85003552 | MN -41 | 10:7536 |
| 6 | *See* EGG-M-17584 | DE85003417 | MN -71 | 10:6453 |
| 7 | *See* EGG-M-18184 | DE85003407 | MN -41 | 10:7538 |
| 8 | *See* PNL-SA-12535 | DE85003641 | MN -41 | 10:7541 |
| CONF-840971- | (1. annual Pittsburgh coal conference, Pittsburgh, PA, USA, 17-21 Sep 1984) | | | |
| 6 | *See* BNL-35395 | DE85003499 | MN -90 | 10:6346 |
| CONF-840978- | (International symposium on high temperature corrosion in energy systems, Detroit, MI, USA, 17-19 Sep 1984) | | | |
| 4 | *See* EGG-M-25783 | DE85003403 | MN -90c | 10:6271 |
| CONF-840981- | (11. international symposium on discharges and electrical insulation in vacuum, Berlin, F.R. Germany, 24-28 Sep 1984) | | | |
| 4 | *See* GEPP-OP-802b | DE85002736 | MN -38 | 10:7298 |
| CONF-8409108- | (IEEE-IAS meeting, Chicago, IL, USA, 30 Sep-4 Oct 1984) | | | |
| 6 | NTIS, PC A02; 3 | DE85002480 | MN -38 | 10:7258 |
| CONF-8409115- | (6. annual Low-Level Waste Management Program participants' information meeting, Denver, CO, USA, 11-13 Sep 1984) | | | |
| 13 | *See* PNL-SA-12512 | DE85003113 | MN -70B | 10:6524 |
| 14 | NTIS, PC A02/MF A01 (GPO Dep.) | DE85003544 | MN -70B | 10:6516 |
| 15 | *See* EGG-M-23584 | DE85003424 | MN -70B | 10:6480 |
| 16 | *See* EGG-M-23284 | DE85003400 | MN -70B | 10:6479 |
| 17 | *See* PNL-SA-12501 | DE85003640 | MN -70B | 10:6523 |
| Absts. | NTIS, PC A05/MF A01; 1 (GPO Dep.) | DE84016490 | MN -70B | 10:6467 |
| CONF-8409117- | (2. international conference on the science of hard materials, Rhodes, Greece, 23-28 Sep 1984) | | | |
| 4 | NTIS, PC A02; 3 | DE85002767 | MN -25 | 10:7137 |
| CONF-8409161- | (5. symposium on neutron dosimetry, Munich, F.R. Germany, 17-21 Sep 1984) | | | |
| 3 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | DE85001128 | MN -37 | 10:7336 |
| CONF-8409162- | (6. international symposium on high energy spin physics, Marseille, France, 12-19 Sep 1984) | | | |
| 4 | *See* BNL-35379 | DE85003207 | MN -34D | 10:7666 |
| CONF-8409179- | (American Institute of Mining, Metallurgical and Petroleum Engineers conference, Detroit, MI, USA, 17-21 Sep 1984) | | | |
| 1 | *See* SERI/TP-255-2492 | DE85000511 | STD -62 | 10:7107 |
| CONF-8409181- | (NATO advanced study institute on fundamental and technological aspects of Organo-F-Element chemistry, Acquafredda di Maratea, Italy, 10-21 Sep 1984) | | | |
| 1 | *See* LBL-18582 | DE85003469 | MN -4 | 10:7099 |
| CONF-841007- | (Nuclear science symposium, Orlando, FL, USA, 31 Oct-2 Nov 1984) | | | |
| 28 | *See* FNAL/C-84-116 | DE85002870 | MN -28 | 10:7337 |
| 29 | *See* SLAC-PUB-3476 | DE85003091 | MN -28 | 10:7312 |
| 30 | *See* UCRL-91723 | DE85003225 | MN -15 | 10:7184 |
| 31 | *See* LBL-17781 | DE85003468 | MN -48 | 10:7463 |
| 32 | *See* DP-MS-84-114 | DE85003658 | MN -15 | 10:6536 |
| CONF-841010- | (Meeting of the Plasma Physics Division of the American Physical Society, Boston, MA, USA, 27 Oct-3 Nov 1984) | | | |
| 9 | *See* UCRL-91174 | DE85003139 | MN -21 | 10:8069 |
| CONF-841014- | (International conference on nuclear and radiochemistry, Lindau, Bodensee, F.R. Germany, 8-12 Oct 1984) | | | |
| 2 | *See* EGG-M-04184 | DE85003427 | MN -78 | 10:6826 |
| CONF-841043- | (37. Pacific Coast regional meeting of the American Ceramic Society, San Francisco, CA, USA, 28-31 Oct 1984) | | | |
| 1 | *See* EGG-M-14884 | DE85003550 | MN -25 | 10:7139 |
| 2 | *See* PNL-SA-12678 | DE85003630 | MN -70 | 10:6499 |
| CONF-841058- | (Fall meeting of the Electrochemical Society, New Orleans, LA, US, 7-12 Oct 1984) | | | |
| 11 | *See* SERI/TP-212-2528 | DE85000538 | MN -63 | 10:6580 |
| CONF-841059- | (3. American Meteorological Society conference on mountain meteorology, Portland, OR, USA, 15-19 Oct 1984) | | | |
| 13 | *See* RFP-3730 | DE85003213 | MN -11 | 10:7365 |
| CONF-841071- | (European wind energy conference and exhibition, Hamburg, F.R. Germany, 23-26 Oct 1984) | | | |
| 2 | *See* SERI/TP-217-2530 | DE85000529 | MN -60 | 10:6732 |
| CONF-841074- | (Thermohydraulics and boiling in liquid metals conference, Grenoble, France, 23-26 Oct 1984) | | | |
| 2-Rev. | NTIS, PC A02/MF A01; 1 (GPO Dep.) | DE85003032 | MN -79p | 10:6819 |

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|---|---|---|---|---|
| CONF-841075- | (International thermal hydraulics and plant operations topical meeting, Taipei, Taiwan, 22-24 Oct 1984) | | | |
| 4 | *See* BNL-NUREG-35281 | TI85001234 | MN -78 | 10:6815 |
| CONF-841093- | (Specialist meeting on steam generator problems, Stockholm; Sweden, 1-5 Oct 1984) | | | |
| 1 | *See* PNL-SA-12531 | DE85003108 | MN -78 | 10:6760 |
| CONF-841094- | (International workshop on irradiated fuel storage--operating experience and development programs, Toronto, Ontario, Canada, 17-18 Oct 1984) | | | |
| 2 | *See* EGG-M-23184 | DE85003261 | MN -85 | 10:6454 |
| CONF-8410103- | (Automotive technology development contractors' coordination meeting, Dearborn, MI, USA, 29 Oct-2 Nov 1984) | | | |
| 1 | *See* DOE/NASA/50194-41 | DE85003887 | STD -96 | 10:7061 |
| CONF-8410142- | (12. water reactor safety research information meeting, Gaithersburg, MD, USA, 23-26 Oct 1984) | | | |
| 4 | *See* SAND-84-1652C | DE85001711 | MN -80 | 10:6877 |
| 6 | NTIS, PC A02/MF A01 (GPO Dep.) | DE85000272 | MN -78 | 10:6822 |
| 7 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | DE85000271 | MN -78 | 10:6823 |
| 8 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | DE85000593 | MN -78 | 10:6824 |
| 19 | *See* SAND-84-2075C | DE85000411 | MN -78 | 10:6880 |
| 20 | *See* SAND-84-1814C | DE85000412 | MN -78 | 10:6879 |
| 25 | NTIS, PC A02/MF A01 (GPO Dep.) | DE85002320 | MN -80 | 10:6781 |
| 37 | *See* PNL-SA-12500 | DE85002537 | MN -78 | 10:6875 |
| 38 | NTIS, PC A02/MF A01 (GPO Dep.) | DE85003023 | MN -78 | 10:6789 |
| 40 | NTIS, PC A03/MF A01 (GPO Dep.) | DE85003084 | MN -78 | 10:6825 |
| 43 | *See* EGG-M-23884 | DE85003413 | MN -78 | 10:6754 |
| 54 | *See* EGG-M-18484 | DE85003590 | MN -78 | 10:6830 |
| 60 | *See* EGG-M-19484 | DE85003415 | MN -78 | 10:6831 |
| 61 | *See* EGG-M-22884 | DE85003416 | MN -78 | 10:6832 |
| CONF-8410144- | (International symposium on nuclear shell model, Philadelphia, PA, USA, 31 Oct-3 Nov 1984) | | | |
| 2 | NTIS, PC A02/MF A01 (GPO Dep.) | DE85003547 | MN -34C | 10:7668 |
| CONF-8410150- | (Special functions: theoretical and computational aspects, Torino, Italy, 10-12 Oct 1984) | | | |
| 1 | NTIS, PC A02; 3 | DE85000069 | MN -32 | 10:8087 |
| CONF-8410156- | (Fall meeting of the Western States Section of the Combustion Institute, Stanford, CA, USA, 22-23 Oct 1984) | | | |
| 5 | *See* SAND-84-8928 | DE85002862 | MN -96 | 10:7306 |
| CONF-8410157- | (Scientific seminar on the behavior of technetium in the environment, Cadarache, France, 23-26 Oct 1984) | | | |
| 5 | *See* PNL-SA-12715 | DE85003600 | MN -48 | 10:7494 |
| CONF-8410163- | (National safety congress, Chicago, IL, USA, 15-18 Oct 1984) | | | |
| 2 | *See* EGG-M-17384 | DE85003554 | MN -41 | 10:7537 |
| CONF-8410166- | (Plutonium/uranium recovery operations conference, Oak Ridge, TN, USA, 16-18 Oct 1984) | | | |
| 1 | *See* NLCO-2022 | DE85002193 | MN -10 | 10:6429 |
| 3 | *See* NLCO-2021 | DE85003484 | MN -47 | 10:6530 |
| CONF-8410173- | (International meeting on reduced enrichment for research and test reactors, Argonne, IL, USA, 14-18 Oct 1984) | | | |
| 2 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | DE85002250 | MN -22 | 10:6801 |
| CONF-8410187- | (INTOR workshop, Vienna, Austria, 25-29 Oct 1984) | | | |
| 1 | NTIS, PC A08/MF A01; 1 (GPO Dep.) | DE85002484 | MN -20 | 10:7998 |
| CONF-841105- | (Joint meeting of the American Nuclear Society and the Atomic Industrial Forum, Washington, DC, USA, 11-16 Nov 1984) | | | |
| 42 | *See* EGG-M-15584 | DE85003256 | MN -78 | 10:6828 |
| 43 | *See* EGG-M-15684 | DE85003264 | MN -78 | 10:6829 |
| 44 | *See* EGG-M-15184 | DE85003265 | MN -70B | 10:6478 |
| 45 | *See* EGG-M-14384 | DE85003257 | MN -78 | 10:6827 |
| 46 | *See* EGG-TIO-M-00784 | DE85003263 | MN -78 | 10:6834 |
| 47 | *See* PNL-SA-12428 | DE85003643 | MN -2 | 10:6874 |
| 48 | *See* DP-MS-84-86 | DE85003564 | MN -70 | 10:6472 |
| CONF-841115- | (International conference on power plant simulation, Mexico City, Mexico, 19-21 Nov 1984) | | | |
| 4 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | DE85000578 | MN -78 | 10:6820 |
| 6 | *See* EGG-M-25384 | DE85003258 | MN -78 | 10:6833 |
| CONF-841116- | (ASM conference on coatings and bimetallics for energy systems and chemical process environments, Hilton Head Island, SC, USA, 13-15 Nov 1984) | | | |
| 1 | *See* SAND-84-1286C | DE85003530 | MN -25 | 10:7106 |
| CONF-841117- | (8. conference on the application of accelerators in research and industry, Denton, TX, USA, 12-14 Nov 1984) | | | |
| 21-Rev. | *See* LBL-17996-Rev. | DE85002900 | MN -28 | 10:7330 |
| 22 | *See* BNL-35347 | DE85003628 | MN -28 | 10:7307 |
| 23 | *See* PNL-SA-12407 | DE85003636 | MN -41 | 10:7892 |
| 24 | *See* PNL-SA-12414 | DE85003635 | MN -34A | 10:7582 |
| 25 | *See* LBL-18501 | DE85003471 | MN -28 | 10:7331 |

| *Report Number* | *Availability Source* | *File Number* | *Distribution Category* | *Abstract Number* |
|---|---|---|---|---|
| **CONF-841121-** | (AIChE annual meeting, San Francisco, CA, USA, 25-29 Nov 1984) | | | |
| 10 | NTIS, PC A02; 3 | DE85003300 | MN -4 | 10:8080 |
| 11 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | DE85003760 | MN -90e | 10:6347 |
| **CONF-841129-** | (1. international photovoltaic science and engineering conference and exhibition, Kobe, Japan, 13-16 Nov 1984) | | | |
| 2 | *See* SERI/TP-211-2543 | DE85000532 | MN -63 | 10:6579 |
| 3 | *See* SERI/TP-211-2537 | DE85000531 | MN -63 | 10:6578 |
| 4 | *See* SERI/TP-211-2520 | DE85000536 | MN -63 | 10:6577 |
| **CONF-841157-** | (Symposium on the scientific basis for nuclear waste management, Boston, MA, USA, 26-29 Nov 1984) | | | |
| 19 | *See* EGG-M-14684 | DE85001551 | MN -25 | 10:7070 |
| 20 | *See* SAND-84-1271C | DE85003449 | MN -25 | 10:7164 |
| 21 | *See* PNL-SA-12369 | DE85003642 | MN -70 | 10:6522 |
| **CONF-841174-** | (5. information exchange meeting on debris coolability, Los Angeles, CA, USA, 7-9 Nov 1984) | | | |
| 8 | *See* BNL-NUREG-35287 | TI85000885 | MN -78 | 10:6817 |
| **CONF-841179-** | (Photovoltaics--research to reality 2 conference, San Diego, CA, USA, 5-7 Nov 1984) | | | |
| 1 | *See* PNL-SA-12711 | DE85003638 | MN -63 | 10:6591 |
| **CONF-841184-** | (30. annual conference on magnetism and magnetic materials, San Diego, CA, USA, 27-30 Nov 1984) | | | |
| 13 | *See* BNL-35371 | DE85003209 | MN -34 | 10:7894 |
| 14 | *See* BNL-35315 | DE85003224 | MN -25 | 10:7073 |
| 15 | *See* MLM-3192(OP) | DE85003309 | MN -25 | 10:7140 |
| 16 | *See* MLM-3219(OP) | DE85003303 | MN -25 | 10:7142 |
| 17 | *See* BNL-35403 | DE85003607 | MN -25 | 10:7075 |
| 18 | *See* BNL-35424 | DE85003608 | MN -25 | 10:7076 |
| 19 | *See* LA-UR-84-3487 | DE85003754 | MN -25 | 10:7096 |
| **CONF-841187-** | (5. DOE environmental protection information meeting, Albuquerque, NM, USA, 6-8 Nov 1984) | | | |
| 2 | *See* Y/DZ-136 | DE85002620 | MN -69 | 10:7408 |
| 3 | *See* DP-MS-84-125 | DE85002827 | MN -70 | 10:6517 |
| 4 | *See* DP-MS-84-110 | DE85002831 | MN -70B | 10:6473 |
| 8 | *See* PNL-SA-12395 | DE85003602 | MN -86 | 10:7383 |
| 9 | *See* PNL-SA-12708 | DE85003629 | MN -70A | 10:6533 |
| 10 | *See* MLM-3218(OP) | DE85003305 | MN -70A | 10:6529 |
| 11 | *See* DP-MS-84-91 | DE85003560 | MN -11 | 10:7417 |
| 12 | *See* DP-MS-84-89 | DE85003565 | MN -11 | 10:7416 |
| 13 | *See* DP-MS-84-99 | DE85003563 | MN -11 | 10:7414 |
| 14 | *See* MLM-3217(OP) | DE85003304 | MN -11 | 10:7540 |
| **CONF-8411109-** | (Workshop on enelastic deformation and failure modes, Evanston, IL, USA, 18-21 Nov 1984) | | | |
| 1 | *See* LA-UR-84-3173 | DE85002206 | MN -34 | 10:7263 |
| **CONF-8411113-** | (Seminar on nuclear safeguards, College Station, TX, USA, 20-21 Nov 1984) | | | |
| 1 | *See* SAND-84-2218C | DE85002439 | MN -15 | 10:6540 |
| **CONF-8411119-** | (IEEE ultrasonics symposium, Dallas, TX, USA, 14-16 Nov 1984) | | | |
| 1 | *See* SAND-84-1341C | DE85003803 | MN -79p | 10:6876 |
| **CONF-841201-** | (ASME winter annual meeting, New Orleans, LA, USA, 9-13 Dec 1984) | | | |
| 18 | *See* SERI/TP-252-2332 | DE84013028 | STD -64 | 10:6605 |
| 20 | *See* SERI/TP-252-2331 | DE85000504 | STD -64 | 10:6604 |
| 21 | *See* UCRL-91786 | DE85003452 | MN -90c | 10:6281 |
| **CONF-841218-** | (31. national vacuum symposium, Reno, NV, USA, 3-7 Dec 1984) | | | |
| 6 | *See* BNL-35401 | DE85003208 | MN -28 | 10:7332 |
| 7 | *See* LBL-18016 | DE85003456 | MN -20 | 10:8053 |
| 8 | *See* LBL-18008 | DE85003457 | MN -20 | 10:8052 |
| 9 | *See* UCRL-91120 | DE85003615 | MN -20 | 10:7991 |
| 11 | *See* LA-UR-84-3488 | DE85003725 | MN -4 | 10:7097 |
| **CONF-841231-** | (DOE/ORNL heat pump conference, Washington, DC, USA, 10-13 Dec 1984) | | | |
| 1 | NTIS, PC A02/F A01 (GPO Dep.) | DE85003332 | MN -95d | 10:6970 |
| 2 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | DE85003334 | MN -95d | 10:6971 |
| **CONF-841247-** | (4. simposio chileno de fisica, Santiago, Chile, 26-28 Dec 1984) | | | |
| 1-Abst. | NTIS, PC A02/MF A01 (GPO Dep.) | DE85002505 | MN -20 | 10:7078 |
| 2-Abst. | NTIS, PC A02/MF A01 (GPO Dep.) | DE85002744 | MN -25 | 10:7079 |
| **CONF-841248-** | (Geochemistry of radionuclide migration meeting, Oak Ridge, TN, USA, 6-7 Dec 1984) | | | |
| 1 | NTIS, PC A02/MF A01 (GPO Dep.) | DE85003337 | MN -70 | 10:7555 |
| **CONF-850101-** | (International congress on hydrology of rocks of low permeability, Tucson, AZ, USA, 7-12 Jan 1985) | | | |
| 1 | *See* SAND-84-0126C | DE85001358 | MN -70 | 10:7552 |
| **CONF-850103-** | (2. symposium on space nuclear power systems, Albuquerque, NM, USA, 14-16 Jan 1985) | | | |
| 2 | *See* LA-UR-84-3388 | DE85002411 | MN -33 | 10:6774 |
| 3 | *See* LA-UR-84-3440 | DE85002433 | MN -33 | 10:6806 |

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|---|---|---|---|---|
| **CONF-850105-** | (ASHRAE symposium on field measurements of heat transfer in building envelopes, Chicago, IL, USA, 27-31 Jan 1985) | | | |
| 1 | *See* LBL-17173 | DE84012254 | MN -95d | 10:6988 |
| 2 | *See* LBL-18149 | DE84016951 | MN -95d | 10:6990 |
| 3 | *See* LBL-17459 | DE84016948 | MN -95d | 10:6989 |
| **CONF-850106-** | (18. midyear topical symposium of the Health Physics Society, Colorado Springs, CO, USA, 6-10 Jan 1985) | | | |
| 1 | *See* LA-UR-84-3390 | DE85002379 | MN -41 | 10:7392 |
| 2 | *See* LA-UR-84-3353 | DE85002389 | MN -41 | 10:7391 |
| **CONF-850108-** | (SCS multiconference on modeling and simulation, San Diego, CA, USA, 24-26 Jan 1985) | | | |
| 2 | *See* UCRL-91263 | DE85001214 | MN -32 | 10:8095 |
| 3 | *See* UCRL-91261 | DE85001213 | MN -32 | 10:8094 |
| **CONF-850110-** | (International conference on neutron scattering in the '90s, Juelich, F.R. Germany, 14-18 Jan 1985) | | | |
| 1 | NTIS, PC A02/MF A01 (GPO Dep.) | DE84015850 | MN -34C | 10:7159 |
| **CONF-850115-** | (64. annual Transportation Research Board meeting, Washington, DC, USA, 21-25 Jan 1985) | | | |
| 1 | NTIS, PC A03/MF A01 (GPO Dep.) | DE84016319 | MN -96 | 10:7058 |
| 2 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | DE84017495 | MN -96 | 10:7033 |
| 3 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | DE85003033 | MN -11 | 10:7370 |
| 4 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | DE85003024 | MN -96 | 10:7059 |
| **CONF-850116-** | (International conference on advances in numerical methods in engineering: theory and applications, Swansea, UK, 7-11 Jan 1985) | | | |
| 1 | *See* LA-UR-84-2749 | DE84016777 | MN -38 | 10:7273 |
| **CONF-850118-** | (3. international modal analysis conference, Orlando, FL, USA, 28-31 Jan 1985) | | | |
| 3-Draft | *See* SAND-84-2092C | DE85002003 | MN -22 | 10:6431 |
| 4 | *See* UCRL-90848 | DE84017569 | MN -21 | 10:8068 |
| **CONF-850131-** | (International conference on systems science, Honolulu, HI, USA, 1 Jan 1985) | | | |
| 1 | *See* LA-UR-84-3428 | DE85002432 | MN -32 | 10:8089 |
| 2 | *See* UCRL-91253 | DE85003146 | MN -32 | 10:8093 |
| **CONF-850132-** | (3. conference on climate variations, Los Angeles, CA, USA, 8-11 Jan 1985) | | | |
| 1 | *See* LA-UR-84-3447 | DE85002434 | MN -11 | 10:7364 |
| **CONF-850133-** | (Optical Society of America topical meeting on optical remote sensing of the atmosphere, Lake Tahoe, NV, USA, 15-18 Jan 1985) | | | |
| 1 | *See* LA-UR-84-3068 | DE85000658 | MN -34B | 10:8088 |
| **CONF-850135-** | (American Astrophysical Society meeting, Tucson, AZ, USA, 13-16 Jan 1985) | | | |
| 1 | *See* LA-UR-84-3469 | DE85003745 | MN -34B | 10:7561 |
| **CONF-850310-** | (6. topical meeting on the technology of fusion energy, San Francisco, CA, USA, 3-7 Mar 1985) | | | |
| 10 | *See* LBL-18530 | DE85003459 | MN -20 | 10:8054 |
| **COO-** | | | | |
| 1195-495 | *See* DOE/ER/01195-495 | DE85000714 | MN -34D | 10:7606 |
| **CRO-RK-** | | | | |
| 6151-MCO-1 | Dutch State Mines, Heerlen, Netherlands | | | 10:6305 |
| **CSNI-** | | | | |
| 76 | *See* CONF-8305220- | DE85003234 | MN -11 | 10:6821 |
| **DESY-** | | | | |
| 84-033 | NTIS (US Sales Only), PC A02/MF A01 | DE84752296 | MN -34D | 10:7603 |
| 84-034 | NTIS (US Sales Only), PC A02/MF A01 | DE84752297 | MN -34D | 10:7669 |
| 84-035 | NTIS (US Sales Only), PC A02/MF A01 | DE84752299 | MN -34D | 10:7622 |
| 84-036 | NTIS (US Sales Only), PC A02/MF A01 | DE84752295 | MN -34D | 10:7604 |
| 84-039 | NTIS (US Sales Only), PC A02/MF A01 | DE84752298 | MN -34D | 10:7605 |
| **DOE/AD/11256-** | | | | |
| T1 | NTIS, PC A06/MF A01; 1 (GPO Dep.) | DE85003822 | MN -98G | 10:7419 |
| **DOE/BC/10033-** | | | | |
| 2 | NTIS | | | 10:6358 |
| **DOE/BC/10310-** | | | | |
| 20 | NTIS | | | 10:6359 |
| **DOE/BC/10327-** | | | | |
| 21 | NTIS, PC A06/MF A01; 1 (GPO Dep.) | DE85000101 | STD -92a | 10:6360 |
| **DOE/BC/10344-** | | | | |
| 4 | NTIS | | | 10:6361 |
| **DOE/BETC/OR-** | | | | |
| 14 | NTIS | | | 10:6362 |
| **DOE/CE-** | | | | |
| 0089 | NTIS, PC A02/MF A01 (GPO Dep.) | DE85003503 | MN -59b | 10:6608 |
| 0095 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | DE85003197 | MN -59b | 10:6609 |
| 0096 | NTIS, PC A02/MF A01 (GPO Dep.) | DE85003198 | MN -59a | 10:6610 |
| **DOE/CH/10166-** | | | | |
| T1 | NTIS, PC A06/MF A01; 1 (GPO Dep.) | DE85003298 | MN -95d | 10:6985 |
| **DOE/CS/20097-** | | | | |
| T1 | NTIS, PC A07/MF A01 (GPO Dep.) | DE85001490 | MN -95 | 10:7054 |
| **DOE/CS/30159-** | | | | |
| T4 | NTIS MF A01; 2 (GPO Dep.) | DE85000451 | MN -59b | 10:6611 |

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|---|---|---|---|---|
| DOE/CS/30280-T2 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | DE83003298 | MN -59b | 10:6566 |
| DOE/CS/30343-T1 | NTIS, PC A10; 3 | DE84017411 | MN -59b | 10:6612 |
| DOE/CS/30393-T1 | NTIS, PC A07; 3 | DE85001308 | MN -58 | 10:6613 |
| DOE/CS/30599-T2 | NTIS, PC A03/MF A01 (GPO Dep.) | DE85002673 | MN -62b | 10:6636 |
| DOE/CS/34293-T2 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | DE85004411 | MN -59a | 10:6637 |
| DOE/CS/34976-T1 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | DE85003299 | MN -59a | 10:6614 |
| DOE/CS/40091-T13 | Univ. City Science Center, 3624 Market Street, Philadelphia, PA 19104 | TI85000421 | ND -95f | 10:7041 |
| DOE/CS/54209-15 | NTIS, PC A04/MF A01; 1 (GPO Dep.) | DE85004585 | STD -96 | 10:7068 |
| DOE/CS/54262-T1 | NTIS, PC A15/MF A01; 1 (GPO Dep.) | DE85002855 | MN -96 | 10:7034 |
| DOE/DP/40124-69 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | DE85003120 | MN -21 | 10:7924 |
| DOE/DP/40175-1 | NTIS, PC A07/MF A01; 1 (GPO Dep.) | DE85003526 | MN -21 | 10:7925 |
| DOE/DR/00789-T4 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | DE85001461 | MN -62 | 10:6594 |
| T5 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | DE85001462 | MN -62 | 10:6595 |
| T9 | NTIS, PC A04/MF A01; 1 (GPO Dep.) | DE85000825 | MN -62a | 10:6596 |
| DOE/EA-0098 | NTIS | | | 10:6393 |
| DOE/EI/02295-T5 | NTIS, PC A05/MF A01; 1 (GPO Dep.) | DE85002888 | MN -13 | 10:7418 |
| DOE/EI/10357-T1 | NTIS, PC A02/MF A01 (GPO Dep.) | DE85002864 | MN -98B | 10:6387 |
| DOE/EIA-0130 | NTIS, PC A07/MF A01; 1 - GPO (GPO Dep.) | DE85003619 | MN -98C | 10:6401 |
| 0226(84/ 08) | NTIS, PC A03/MF A01 - GPO (GPO Dep.) | DE85003440 | MN -98E | 10:6952 |
| 0321/ 1(82) | NTIS, PC A10/MF A01; 1 - GPO (GPO Dep.) | DE85003461 | MN -98 | 10:6958 |
| 0341(83) | NTIS, PC A04/F A01 - GPO (GPO Dep.) | DE85003669 | MN -98 | 10:6960 |
| 0439(84) | NTIS, PC A04/MF A01; 1 - GPO (GPO Dep.) | DE85003598 | MN -98 | 10:6782 |
| M001 | NTIS, PC A06/MF A01; 1 - GPO (GPO Dep.) | DE85004587 | MN -98 | 10:6953 |
| DOE/EIS-0066/ F | NTIS, PC A99/MF A01; 1 (GPO Dep.) | DE85003561 | STD -11 | 10:7422 |
| DOE/EP/15100-T13 | NTIS, PC A05/MF A01 (GPO Dep.) | DE85003687 | MN -13 | 10:7535 |
| DOE/ER/01195-495 | NTIS, PC A07/MF A01; 1 (GPO Dep.) | DE85000714 | MN -34D | 10:7606 |
| DOE/ER/04062-91 | NTIS, PC A02/MF A01 (GPO Dep.) | DE85003240 | MN -4 | 10:7217 |
| DOE/ER/04310-T2 | NTIS, PC A02/MF A01 (GPO Dep.) | DE85003075 | MN -48 | 10:7426 |
| DOE/ER/04426-7 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | DE85003319 | MN -4 | 10:7249 |
| DOE/ER/04759-6 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | DE85003314 | MN -4 | 10:7250 |
| DOE/ER/05096-15 | NTIS, PC A07; 3 | DE85003030 | MN -34D | 10:7607 |
| DOE/ER/05246-T2 | NTIS, PC A04/MF A01; 1 (GPO Dep.) | DE85000858 | MN -94d | 10:7080 |
| DOE/ER/06484-T1 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | DE85002896 | MN -21 | 10:7272 |
| DOE/ER/10107-24 | NTIS, PC A02/MF A01 (GPO Dep.) | DE85003668 | MN -20c | 10:7081 |
| DOE/ER/10347-T1 | NTIS, PC A08/MF A01; 1 (GPO Dep.) | DE85003820 | MN -96 | 10:6967 |
| DOE/ER/10348-6 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | DE85003074 | MN -34 | 10:7082 |
| DOE/ER/10623-T3 | NTIS, PC A02; 3 | TI85001597 | MN -61d | 10:6552 |
| DOE/ER/10740-13 | NTIS, PC A05/MF A01; 1 (GPO Dep.) | DE85000422 | MN -25 | 10:7296 |
| DOE/ER/10855-4 | NTIS, PC A02/MF A01 (GPO Dep.) | DE85003316 | MN -4 | 10:6544 |
| DOE/ER/10859-3 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | DE85003313 | MN -4 | 10:7174 |
| DOE/ER/10867-T1 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | DE85002857 | MN -38 | 10:7277 |
| DOE/ER/10912-T2 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | DE85002851 | MN -4 | 10:7157 |
| DOE/ER/10914-T2 | NTIS, PC A06/MF A01; 1 (GPO Dep.) | DE85003704 | MN -90d | 10:6255 |
| DOE/ER/10917-2 | NTIS, PC A02/MF A01 (GPO Dep.) | DE85003700 | MN -48 | 10:7502 |
| DOE/ER/10936-T1 | NTIS, PC A02/MF A01 (GPO Dep.) | DE85004329 | MN -25 | 10:7160 |

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| T2 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | DE85004353 | MN -25 | 10:7161 |
| T3 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | DE85004352 | MN -25 | 10:7162 |
| DOE/ER/12054-2 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | DE85003620 | MN -38 | 10:7354 |
| DOE/ER/12077-T2 | NTIS, PC A02/MF A01 (GPO Dep.) | DE85002645 | MN -25 | 10:7083 |
| DOE/ER/13000-T3 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | DE85003229 | MN -48 | 10:7571 |
| DOE/ER/13026-3 | NTIS, PC A03/MF A01 (GPO Dep.) | DE85003467 | MN -63b | 10:6568 |
| DOE/ER/13038-T1 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | DE85003220 | MN -38 | 10:7304 |
| DOE/ER/13145-T1 | NTIS, PC A02/MF A01 (GPO Dep.) | DE85003701 | MN -32 | 10:7901 |
| DOE/ER/13150-T1 | NTIS, PC A02/MF A01 (GPO Dep.) | DE84017590 | MN -4 | 10:7084 |
| DOE/ER/30059-T1 | NTIS, PC A04/MF A01 (GPO Dep.) | DE85002664 | MN -38 | 10:6917 |
| DOE/ER/45026-2 | NTIS, PC A02/MF A01 (GPO Dep.) | DE85002893 | MN -38 | 10:7259 |
| DOE/ER/45057-T1 | NTIS, PC A04/MF A01; 1 (GPO Dep.) | DE85003506 | MN -25 | 10:7287 |
| DOE/ER/53173-T1 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | DE85003612 | MN -20 | 10:7926 |
| DOE/ER/60044-1 | NTIS, PC AA03/MF A01 (GPO Dep.) | DE85002981 | MN -11 | 10:7371 |
| DOE/ER/71128-T1 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | DE85003750 | MN -25 | 10:7085 |
| DOE/ET/11423-T7 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | DE85003830 | MN -90a | 10:6286 |
| T8 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | DE85003828 | MN -90a | 10:6287 |
| T9 | NTIS, PC A02/MF A01 (GPO Dep.) | DE85003834 | MN -90a | 10:6288 |
| T10 | NTIS, PC A02/MF A01 (GPO Dep.) | DE85003829 | MN -90a | 10:6289 |
| T11 | NTIS, PC A02/MF A01 (GPO Dep.) | DE85003841 | MN -90a | 10:6290 |
| T12 | NTIS, PC A02/MF A01 (GPO Dep.) | DE85003842 | MN -90a | 10:6291 |
| DOE/ET/12056-22 | NTIS | | | 10:6376 |
| 24 | NTIS | | | 10:6377 |
| 31 | NTIS | | | 10:6378 |
| DOE/ET/12065-26 | NTIS | | | 10:6379 |
| DOE/ET/12130-113 | NTIS | | | 10:6356 |
| DOE/ET/12138-1388 | NTIS, PC A04/MF A01; 1 | DE83009300 | MN -92a | 10:6256 |
| DOE/ET/12162-T1 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | DE85000022 | STD -90a | 10:6292 |
| DOE/ET/12236-1 | NTIS, PC A05/MF A01; 1 (GPO Dep.) | DE85003671 | MN -96 | 10:7060 |
| DOE/ET/14690-T2-Vol.1 | NTIS, PC A06/MF A01 (GPO Dep.) | DE85004196 | MN -90 | 10:6331 |
| T2-Vol.2 | NTIS, PC A07/MF A01 (GPO Dep.) | DE85004195 | MN -90 | 10:6332 |
| T2-Vol.3 | NTIS, PC A07/MF A01 (GPO Dep.) | DE85003759 | MN -90 | 10:6333 |
| T2-Vol.4 | NTIS, PC A07/MF A01; 1 (GPO Dep.) | DE85004198 | MN -90 | 10:6334 |
| T2-Vol.5 | NTIS, PC A07/MF A01; 1 (GPO Dep.) | DE85004197 | MN -90 | 10:6335 |
| DOE/ET/14804-T4 | NTIS, PC A02; 3 | DE85003706 | MN -90d | 10:6257 |
| DOE/ET/14809-13 | NTIS, PC A04/MF A01 (GPO Dep.) | DE85000648 | STD -90d | 10:6545 |
| DOE/ET/17089-9 | NTIS, PC A03/MF A01 (GPO Dep.) | DE85002978 | STD -93 | 10:6963 |
| DOE/ET/20642-T1 | NTIS, PC A09/MF A01; 1 (GPO Dep.) | DE85000732 | STD -59a | 10:6615 |
| DOE/ET/32002-T1 | NTIS, PC A13/MF A01; 1 (GPO Dep.) | DE85002494 | MN -23 | 10:7066 |
| DOE/ET/34212-45 | NTIS (US Sales Only), PC A06/MF A01; 1 (GPO Dep.) | DE85004347 | STD -78 | 10:6753 |
| DOE/ET/51013-136 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | DE85004406 | STD -20b | 10:7999 |
| DOE/ET/53060-T1 | NTIS, PC A02/MF A01 (GPO Dep.) | DE85003613 | MN -20g | 10:7927 |
| DOE/EV-0005/ 39-Suppl.1 | NTIS, PC A06/MF A01; 1 (GPO Dep.) | DE85001415 | STD -70A | 10:6526 |
| 0005/ 48 | NTIS, PC A07/MF A01 (GPO Dep.) | DE85001420 | STD -70A | 10:6527 |
| DOE/EV/03801-T6 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | DE85004330 | MN -11 | 10:7401 |
| T12 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | DE85003703 | MN -11 | 10:7402 |
| DOE/EV/05461-T1 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | DE85003802 | MN -48 | 10:7425 |
| T2 | NTIS, PC A04/MF A01; 1 (GPO Dep.) | DE85003678 | MN -48 | 10:7398 |
| DOE/EV/70029-T1 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | DE85003825 | MN -11 | 10:7543 |

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| DOE/FC/10159-1 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | DE85004459 | STD -90 | 10:6293 |
| DOE/FE-0017 | NTIS | | | 10:6403 |
| DOE/FE/60088-T3 | NTIS, PC A02; 3 | DE85003833 | MN -90i | 10:6306 |
| DOE/FE/60338-T5 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | DE85003278 | MN -93 | 10:6964 |
| DOE/ID-22067 | NTIS, PC A03/MF A01 (GPO Dep.) | DE85002168 | STD -70 | 10:6468 |
| DOE/ID/12427-T1 | NTIS, PC A07/MF A01; 1 (GPO Dep.) | DE85002830 | STD -94 | 10:6890 |
| DOE/ID/12437-1 | NTIS, PC A04/MF A01; 1 (GPO Dep.) | DE85001838 | MN -70B | 10:6469 |
| DOE/ID/12478-T6 | NTIS, PC A04/MF A01; 1 (GPO Dep.) | DE85002355 | MN -66 | 10:6725 |
| DOE/IG-0213 | OSTI | TI85004326 | STD -13 | 10:7297 |
| DOE/JPL/1012-99 | NTIS, PC A22/MF A01; 1 (GPO Dep.) | DE85003481 | STD -63b | 10:6569 |
| DOE/LC/10713-1663 | NTIS, PC A10/MF A01; 1 (GPO Dep.) | DE85001960 | STD -90c | 10:6258 |
| DOE/MC/05301-86 | NTIS | | | 10:6380 |
| DOE/MC/08711-T1 | NTIS, PC A02/MF A01 (GPO Dep.) | DE84017598 | MN -90i | 10:7508 |
| DOE/MC/19301-4 | NTIS, PC A02/MF A01 (GPO Dep.) | DE85003474 | MN -90c | 10:6259 |
| DOE/MC/20334-T13 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | DE85003463 | MN -90e | 10:7305 |
| DOE/METC-84-34 | NTIS, PC A22/MF A01; 1 (GPO Dep.) | DE85001957 | STD -90i | 10:6307 |
| 85-6 | NTIS, PC A04/MF A01; 1 (GPO Dep.) | DE85001959 | MN -13 | 10:6918 |
| DOE/NASA-0238-1 | NTIS, PC A06/MF A01; 1 (GPO Dep.) | DE85003071 | STD -97d | 10:6965 |
| 0330-1 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | DE85003054 | STD -60 | 10:6730 |
| DOE/NASA/50194-41 | NTIS, PC A02/MF A01 (GPO Dep.) | DE85003887 | STD -96 | 10:7061 |
| DOE/NBM-5003626 | NTIS, PC A06/MF A01; 1 (GPO Dep.) | DE85003626 | MN -13 | 10:6947 |
| DOE/NE-0048/ 7 | NTIS, PC A05/MF A01; 1 (GPO Dep.) | DE85000837 | MN -80 | 10:6923 |
| DOE/NV/10250-16 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | DE85003882 | MN -70 | 10:6470 |
| DOE/PC/30021-T14 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | DE85003151 | STD -90d | 10:6546 |
| DOE/PC/30027-56 | NTIS, PC A06/MF A01; 1 (GPO Dep.) | DE85002615 | STD -90d | 10:6260 |
| DOE/PC/40091-T10 | NTIS, PC A04/MF A01; 1 (GPO Dep.) | DE85003792 | STD -90d | 10:6262 |
| DOE/PC/40771-14 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | DE85002311 | STD -90d | 10:6547 |
| DOE/PC/40801-T6 | NTIS, PC A03/MF A01 (GPO Dep.) | DE85003279 | MN -90 | 10:6263 |
| DOE/PC/40802-T1 | NTIS, PC A05/MF A01; 1 (GPO Dep.) | DE85000036 | STD -90d | 10:6348 |
| DOE/PC/40806-7 | NTIS, PC A08/MF A01 (GPO Dep.) | DE85001848 | STD -90a | 10:6308 |
| DOE/PC/50266-7 | NTIS, PC A02/MF A01 (GPO Dep.) | DE85002488 | MN -90b | 10:6349 |
| DOE/PC/50799-T4 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | DE85001850 | MN -90d | 10:6264 |
| T5 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | DE85001851 | MN -90d | 10:6265 |
| DOE/PC/50810-T8 | NTIS, PC A02/MF A01 (GPO Dep.) | DE85002338 | MN -90a | 10:6553 |
| DOE/PC/60015-18 | NTIS, PC A02/MF A01 (GPO Dep.) | DE85000647 | MN -90a | 10:6294 |
| DOE/PC/60054-T4 | NTIS, PC A22/MF A01; 1 (GPO Dep.) | DE85002738 | STD -90d | 10:6266 |
| DOE/PC/60265-T5 | NTIS, PC A02/MF A01 (GPO Dep.) | DE85003486 | MN -90i | 10:6309 |
| DOE/PC/60409-T3-Vol.1 | NTIS, PC A03/MF A01 (GPO Dep.) | DE85003868 | MN -90a | 10:6350 |
| T3-Vol.2 | NTIS, PC A12/MF A01; 1 (GPO Dep.) | DE85003869 | MN -90a | 10:6310 |
| T3-Vol.3 | NTIS, PC A10/MF A01; 1 (GPO Dep.) | DE85003870 | MN -90a | 10:6311 |
| DOE/PC/60785-5 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | DE85003247 | STD -90d | 10:6268 |
| DOE/PC/60795-4 | NTIS, PC A02/MF A01 (GPO Dep.) | DE85003130 | MN -90a | 10:6548 |
| DOE/PC/60807-5 | NTIS, PC A02/MF A01 (GPO Dep.) | DE85003310 | MN -90a | 10:6295 |
| DOE/PC/60808-3 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | DE85003597 | STD -90d | 10:6269 |

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| DOE/PC/61252-T1 | NTIS, PC A08/MF A01; 1 (GPO Dep.) | DE85002616 | STD -90i | 10:7372 |
| DOE/PC/70006-1 | NTIS, PC A04/MF A01; 1 (GPO Dep.) | DE85001241 | STD -90d | 10:6270 |
| DOE/PC/70805-T1 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | DE85002618 | STD -90a | 10:6341 |
| DOE/PC/71503-T1 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | DE85000816 | MN -90a | 10:6342 |
| DOE/PETC/TR-85/2 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | DE85004181 | STD -90d | 10:6549 |
| DOE/R4/10227-T1 | NTIS, PC A02; 3 | DE85000219 | MN -59b | 10:6616 |
| DOE/R4/10463-T1 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | DE85000635 | MN -59a | 10:6617 |
| DOE/RA/50241-T1 | NTIS, PC A07/MF A01; 1 (GPO Dep.) | DE85000385 | STD -66 | 10:6697 |
| DOE/RG/06353-T2 | NTIS, PC A04/MF A01 (GPO Dep.) | DE85001687 | MN -97 | 10:6954 |
| T3 | NTIS, PC A06/MF A01 (GPO Dep.) | DE85001642 | MN -97 | 10:6955 |
| DOE/RG/10237-T1 | NTIS, PC A03; 3 | DE84016526 | MN -98E | 10:6956 |
| DOE/RW-0006 | NTIS, PC A10/MF A01; 1 (GPO Dep.) | DE85003443 | STD -70 | 10:6471 |
| 0007 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | DE85003262 | MN -71 | 10:6452 |
| DOE/S-0028 | NTIS, PC A06/MF A01 (GPO Dep.) | DE85000696 | MN -13 | 10:6414 |
| DOE/SAN/1000-3 | NTIS | | | 10:6381 |
| DOE/SF/00115-T12 | NTIS, PC A02/MF A01 (GPO Dep.) | DE85002868 | MN -4 | 10:7086 |
| DOE/SF/00515-T41 | NTIS, PC A05/MF A01; 1 (GPO Dep.) | DE85003289 | MN -28 | 10:7333 |
| DOE/SF/10501-015 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | DE85001378 | MN -62 | 10:6895 |
| 061 | NTIS, PC A02; 3 | DE84017037 | MN -62a | 10:6597 |
| DOE/SF/11520-T1 | NTIS, PC A24/MF A01; 1 (GPO Dep.) | DE85003246 | STD -66 | 10:6728 |
| DOE/SF/11720-T2 | NTIS, PC A04/MF A01; 1 (GPO Dep.) | DE85002993 | MN -66 | 10:6673 |
| T3 | NTIS, PC A06/MF A01; 1 (GPO Dep.) | DE85002994 | MN -66 | 10:6674 |
| DOE/SF/11946-T1 | NTIS, PC A04/MF A01; 1 (GPO Dep.) | DE85000497 | STD -59a | 10:6638 |
| DOE/TIC/EG-80/29 | NTIS | | | 10:6412 |
| DOE-tr-265 | NTIS, PC A02; 3 | DE85000650 | MN -38 | 10:7294 |
| DP-1689 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | DE85003441 | STD -4 | 10:7138 |
| DP-MS-84-86 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | DE85003564 | MN -70 | 10:6472 |
| 84-89 | NTIS, PC A02/MF A01 (GPO Dep.) | DE85003565 | MN -11 | 10:7416 |
| 84-91 | NTIS, PC A02/MF A01 (GPO Dep.) | DE85003560 | MN -11 | 10:7417 |
| 84-99 | NTIS, PC A02/MF A01 (GPO Dep.) | DE85003563 | MN -11 | 10:7414 |
| 84-110 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | DE85002831 | MN -70B | 10:6473 |
| 84-114 | NTIS, PC A02/MF A01 (GPO Dep.) | DE85003658 | MN -15 | 10:6536 |
| 84-125 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | DE85002827 | MN -70 | 10:6517 |
| DP-Report-1000 | NTIS (US Sales Only), PC A99/MF A01; 1 | DE85900217 | MN -77 | 10:6762 |
| DP-tr-70-84 | NTIS, PC A02/MF A01 (GPO Dep.) | DE84017505 | MN -22 | 10:6515 |
| DPSPU-84-302 | NTIS, PC A14/MF A01; 1 (GPO Dep.) | DE85003616 | MN -11 | 10:7389 |
| DPST-84-1-8 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | DE85001200 | MN -2 | 10:6474 |
| 84-736 | NTIS, PC A03/MF A01 (GPO Dep.) | DE85003657 | MN -38 | 10:7260 |
| E-25/650 | *See* PB-84-237726 | | | 10:7007 |
| ECN-83-105 | Netherlands Energy Research Foundation, Petten | | | 10:6351 |
| EEB-BED-83-07 | *See* LBL-16362 | DE85003454 | MN -95d | 10:6987 |
| EEB-L-84-13 | *See* LBL-18425 | DE85004346 | STD -95c | 10:7035 |
| EFP-TR-32 | *See* SLU-ESO-TR-32 | DE85750230 | MN -61a | 10:6581 |
| EGG-2291 | NTIS, PC A03/MF A01 (GPO Dep.) | DE85003273 | STD -70A | 10:6475 |
| 2321 | NTIS, PC A02/MF A01 (GPO Dep.) | DE85003155 | STD -70 | 10:6476 |
| 2333 | *See* NUREG/CR-3928 | TI85000797 | MN -78 | 10:6869 |
| 2350 | NTIS, PC A03/MF A01 (GPO Dep.) | DE85002861 | STD -70 | 10:6477 |
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| 14384 | NTIS, PC A02/MF A01 (GPO Dep.) | DE85003257 | MN -78 | 10:6827 |
| 14684 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | DE85001551 | MN -25 | 10:7070 |

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| 15184 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | DE85003265 | MN -70B | 10:6478 |
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| 15684 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | DE85003264 | MN -78 | 10:6829 |
| 16684 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | DE85003552 | MN -41 | 10:7536 |
| 17384 | NTIS, PC A02/MF A01 (GPO Dep.) | DE85003554 | MN -41 | 10:7537 |
| 17584 | NTIS, PC A02; 3 | DE85003417 | MN -71 | 10:6453 |
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| 23584 | NTIS, PC A02/MF A01 (GPO Dep.) | DE85003424 | MN -70B | 10:6480 |
| 23884 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | DE85003413 | MN -78 | 10:6754 |
| 25384 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | DE85003258 | MN -78 | 10:6833 |
| 25783 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | DE85003403 | MN -90c | 10:6271 |
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| **EGG-TMI-** | | | | |
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| **EPA-** | | | | |
| 600/ 7-84-027 | *See* TVA/OP/EDT-82/20 | DE85900359 | MN -90d | 10:6741 |
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| 3243-CCM-Vol.1 | NTIS, PC A06/MF A01 - EPRI $14.50 (GPO Dep.) | DE85003680 | MN -78 | 10:6836 |
| 3381-CCM-Vol.1 | Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303, $11.50 | TI85920105 | ND -85 | 10:6455 |
| 3381-CCM-Vol.2 | Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303, $14.50 | TI85920106 | ND -85 | 10:6456 |

| Report Number | Availability Source | File Number | Distribution Category | Abstract Number |
|---|---|---|---|---|
| 3721-SR | Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303, $16.00 | TI85920117 | ND -13 | 10:6919 |
| 3764 | NTIS, PC A05/MF A01 - EPRI (GPO Dep.) | DE85003283 | MN -85 | 10:6457 |
| **ERG-** | | | | |
| 047 | *See* PB-84-232461 | | | 10:6891 |
| **ESL-TM-** | | | | |
| 1642 | *See* AD-A-144998/2 | | | 10:7361 |
| **ETEC-** | | | | |
| 84-20 | *See* UCRL-15632 | DE85003660 | MN -21 | 10:8064 |
| **ETR-** | | | | |
| 318 | NTIS (US Sales Only), PC A11/MF A01 | DE85780073 | MN -86 | 10:6442 |
| **EUR-** | | | | |
| 7710 | NTIS PC E09/MF E09 | | | 10:6618 |
| 7710-EN | *See* EUR-7710 | | | 10:6618 |
| 7993e | *See* KFK-3755 | DE84752309 | MN -20 | 10:8050 |
| 8393 | NTIS PC E08/MF E08 | | | 10:7055 |
| 8393-EN | *See* EUR-8393 | | | 10:7055 |
| 8421-EN | *See* IIASA-RR-83-9 | | | 10:6904 |
| 8660-EN | *See* PB-84-234921 | | | 10:6898 |
| 8661-EN | *See* PB-84-236207 | | | 10:6968 |
| 8715 | NTIS PC E04/MF E04 | | | 10:6676 |
| 8715-EN | *See* EUR-8715 | | | 10:6676 |
| 8716 | NTIS PC E04/MF E04 | | | 10:6720 |
| 8716-FR | *See* EUR-8716 | | | 10:6720 |
| 8717 | NTIS PC E04/MF E04 | | | 10:6677 |
| 8717-FR | *See* EUR-8717 | | | 10:6677 |
| 8718 | NTIS PC E04/MF E04 | | | 10:6678 |
| 8718-FR | *See* EUR-8718 | | | 10:6678 |
| 8719 | NTIS PC E07/MF E07 | | | 10:6721 |
| 8719-EN/ IT | *See* EUR-8719 | | | 10:6721 |
| 8720 | NTIS PC E03/MF E03 | | | 10:6679 |
| 8720-FR | *See* EUR-8720 | | | 10:6679 |
| 8721 | NTIS PC E04/MF E04 | | | 10:6680 |
| 8721-FR | *See* EUR-8721 | | | 10:6680 |
| 8722 | NTIS PC E05/MF E05 | | | 10:6681 |
| 8722-EN/ IT | *See* EUR-8722 | | | 10:6681 |
| 8724 | NTIS PC E04/MF E04 | | | 10:6682 |
| 8724-EN | *See* EUR-8724 | | | 10:6682 |
| 8725 | NTIS PC E06/MF E06 | | | 10:6722 |
| 8725-FR | *See* EUR-8725 | | | 10:6722 |
| 8726 | NTIS PC E04/MF E04 | | | 10:6683 |
| 8726-FR | *See* EUR-8726 | | | 10:6683 |
| 8727 | NTIS PC E04/MF E04 | | | 10:6684 |
| 8727-FR | *See* EUR-8727 | | | 10:6684 |
| 8728 | NTIS PC E04/MF E04 | | | 10:6685 |
| 8728-FR | *See* EUR-8728 | | | 10:6685 |
| 8729 | NTIS PC E06/MF E06 | | | 10:6686 |
| 8729-FR | *See* EUR-8729 | | | 10:6686 |
| 8730 | NTIS PC E04/MF E04 | | | 10:6687 |
| 8730-FR | *See* EUR-8730 | | | 10:6687 |
| 8736 | NTIS PC E08/MF E08 | | | 10:6688 |
| 8736-EN | *See* EUR-8736 | | | 10:6688 |
| 8765 | NTIS PC E05/MF E05 | | | 10:6689 |
| 8765-EN | *See* EUR-8765 | | | 10:6689 |
| 8798-DE-EN | *See* PB-84-234905 | | | 10:6644 |
| 9162 | *See* AECL-8361 | TI84901833 | ND -70 | 10:6465 |
| **FEI-** | | | | |
| 1428 | NTIS (US Sales Only), PC A03/MF A01 | DE84703230 | MN -46 | 10:7867 |
| **FNAL/C-** | | | | |
| 84-116 | NTIS, PC A02; 3 | DE85002870 | MN -28 | 10:7337 |
| **FNAL-TM-** | | | | |
| 1285 | NTIS, PC A02/MF A01; 1 | DE85003721 | STD -12 | 10:7322 |
| 1287 | NTIS, PC A03/MF A01; 1 | DE85003722 | STD -32 | 10:7323 |
| **FS-** | | | | |
| 83-32-T | Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland) | | | 10:7875 |
| **GA-A-** | | | | |
| 17389 | NTIS, PC A08/MF A01; 1 (GPO Dep.) | DE85004394 | STD -20d | 10:8000 |
| 17779 | NTIS, PC A04/MF A01; 1 (GPO Dep.) | DE85004395 | STD -95 | 10:7042 |
| **GEND-** | | | | |
| 042 | NTIS, PC A05/MF A01 (GPO Dep.) | DE85003888 | STD -78 | 10:6849 |
| **GEPP-OP-** | | | | |
| 802b | NTIS, PC A02/MF A01 (GPO Dep.) | DE85002736 | MN -38 | 10:7298 |
| **GJ/TMC-** | | | | |
| 19 | NTIS, PC A06/MF A01; 1 (GPO Dep.) | DE85002529 | STD -70A | 10:7175 |
| **GKSS-** | | | | |
| 83/ E/ 76 | NTIS (US Sales Only), PC A02/MF A01 | DE84752327 | MN -4 | 10:7176 |
| 84/ E/ 10 | NTIS (US Sales Only), PC A09/MF A01 | DE84752311 | MN -78 | 10:6850 |
| **GRI-** | | | | |
| 79-0087 | *See* PB-82-254582 | | | 10:6405 |
| 80-0140 | *See* PB-82-254608 | | | 10:6397 |
| 80-0155 | *See* PB-82-254624 | | | 10:6407 |
| 81-0020 | *See* PB-82-220583 | | | 10:6396 |
| 81-0068 | *See* PB-82-262551 | | | 10:6276 |

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|---|---|---|---|---|
| 81-0072 | *See* PB-82-254632 | | | 10:6406 |
| 82-22778 | *See* PB-82-22778 | | | 10:6402 |
| **GRS-** | | | | |
| 55 | NTIS (US Sales Only), PC A06/MF A01 | DE84752312 | MN -80 | 10:6851 |
| **GRS-A-** | | | | |
| 634 | Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.) | | | 10:6783 |
| 749 | Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.) | | | 10:6784 |
| 885 | *See* BMI-1984-034 | DE84752326 | MN -38 | 10:7276 |
| 936 | *See* BMI-1984-040 | DE84752335 | MN -80 | 10:6809 |
| 937 | *See* BMI-1984-043 | DE84752340 | MN -80 | 10:6780 |
| **GRS-F-** | | | | |
| 135 | NTIS (US Sales Only), PC A04/MF A01 | DE85750010 | MN -80 | 10:6852 |
| **GSF-T-** | | | | |
| 164 | NTIS (US Sales Only), PC A04/MF A01 | DE84752285 | MN -70 | 10:6481 |
| **GSI-** | | | | |
| 84-32-Prepr. | NTIS (US Sales Only), PC A07/MF A01 | DE84752292 | MN -34D | 10:7830 |
| 84-34-Prepr. | NTIS (US Sales Only), PC A03/MF A01 | DE84752337 | MN -25 | 10:7831 |
| 84-36-Prepr. | NTIS (US Sales Only), PC A02/MF A01 | DE84752336 | MN -25 | 10:7760 |
| **GSO-** | | | | |
| 1981-0065 | Geological Survey, Private Bag X112, Pretoria, 0001, South Africa | | ND -51 | 10:6418 |
| 1981-0067 | Geological Survey, Private Bag X112, Pretoria, 0001, South Africa | | ND -51 | 10:6420 |
| 1982-0222 | Geological Survey, Private Bag X112, Pretoria, 0001, South Africa | | ND -51 | 10:6423 |
| **HEDL-SA-** | | | | |
| 3063A | NTIS, PC A02/MF A01; 1 (GPO Dep.) | DE85000292 | MN -78 | 10:6755 |
| 3064A | NTIS, PC A02/MF A01; 1 (GPO Dep.) | DE85001496 | MN -80 | 10:6790 |
| 3102 | NTIS, PC A02/MF A01 (GPO Dep.) | DE85001202 | MN -78 | 10:6802 |
| 3107-FP | NTIS, PC A02/MF A01 (GPO Dep.) | DE85000296 | MN -79 | 10:6803 |
| **HMI-B-** | | | | |
| 398 | NTIS (US Sales Only), PC A07/MF A01 | DE84752307 | MN -25 | 10:7353 |
| **IAE-** | | | | |
| 3714/ 14 | NTIS (US Sales Only), PC A02/MF A01 | DE84703196 | MN -20 | 10:8001 |
| 3752/ 1 | NTIS (US Sales Only), PC A04/MF A01 | DE84703231 | MN -34C | 10:7572 |
| **IC-** | | | | |
| 83/ 32 | NTIS (US Sales Only), PC A05/MF A01 | DE84703184 | MN -34D | 10:7670 |
| 83/ 44 | NTIS (US Sales Only), PC A02/MF A01 | DE84703192 | MN -34D | 10:7671 |
| 83/ 155 | NTIS (US Sales Only), PC A02/MF A01 | DE84703185 | MN -34D | 10:7672 |
| 83/ 156 | NTIS (US Sales Only), PC A02/MF A01 | DE84703225 | MN -34D | 10:7623 |
| 83/ 185 | NTIS (US Sales Only), PC A02/MF A01 | DE84703186 | MN -34D | 10:7673 |
| 83/ 190 | NTIS (US Sales Only), PC A03/MF A01 | DE84703187 | MN -34D | 10:7674 |
| 83/ 191 | NTIS (US Sales Only), PC A02/MF A01 | DE84703193 | MN -34D | 10:7660 |
| 83/ 201 | NTIS (US Sales Only), PC A02/MF A01 | DE84703188 | MN -34D | 10:7675 |
| 83/ 204 | NTIS (US Sales Only), PC A03/MF A01 | DE84703189 | MN -34D | 10:7676 |
| 83/ 206 | NTIS (US Sales Only), PC A02/MF A01 | DE84703224 | MN -34D | 10:7624 |
| 83/ 207 | NTIS (US Sales Only), PC A02/MF A01 | DE84703190 | MN -34D | 10:7677 |
| 83/ 209 | NTIS (US Sales Only), PC A02/MF A01 | DE84703191 | MN -34D | 10:7678 |
| 83/ 230 | NTIS (US Sales Only), PC A02/MF A01 | DE84703228 | MN -34D | 10:7679 |
| 84/ 1 | NTIS (US Sales Only), PC A02/MF A01 | DE85700099 | MN -34D | 10:7680 |
| 84/ 4 | NTIS (US Sales Only), PC A02/MF A01 | DE85700102 | MN -34D | 10:7681 |
| 84/ 5 | NTIS (US Sales Only), PC A02/MF A01 | DE85700094 | MN -34D | 10:7902 |
| 84/ 10 | NTIS (US Sales Only), PC A02/MF A01 | DE85780153 | MN -4 | 10:7201 |
| 84/ 11 | NTIS (US Sales Only), PC A02/MF A01 | DE85700100 | MN -34D | 10:7682 |
| 84/ 12 | NTIS (US Sales Only), PC A03/MF A01 | DE85700132 | MN -34D | 10:7683 |
| 84/ 14 | NTIS (US Sales Only), PC A02/MF A01 | DE85780154 | MN -4 | 10:7202 |
| 84/ 15 | NTIS (US Sales Only), PC A02/MF A01 | DE85700095 | MN -34D | 10:7903 |
| 84/ 16 | NTIS (US Sales Only), PC A02/MF A01 | DE85700137 | MN -34C | 10:7711 |
| 84/ 17 | NTIS (US Sales Only), PC A02/MF A01 | DE85700135 | MN -34C | 10:7712 |
| 84/ 18 | NTIS (US Sales Only), PC A02/MF A01 | DE85700138 | MN -34C | 10:7751 |
| 84/ 21 | NTIS (US Sales Only), PC A02/MF A01 | DE85700096 | MN -34D | 10:7904 |
| 84/ 26 | NTIS (US Sales Only), PC A03/MF A01 | DE85700101 | MN -34D | 10:7684 |
| 84/ 29 | NTIS (US Sales Only), PC A02/MF A01 | DE85700092 | MN -34D | 10:7685 |
| 84/ 30 | NTIS (US Sales Only), PC A02/MF A01 | DE85700093 | MN -34D | 10:7686 |
| **IFVE-OEF-** | | | | |
| 83-119 | NTIS (US Sales Only), PC A02/MF A01 | DE84703229 | MN -34D | 10:7608 |
| **IFVE-ONF-** | | | | |
| 83-45 | NTIS (US Sales Only), PC A02/MF A01 | DE84703219 | MN -34D | 10:7625 |
| **IFVE-OTF-** | | | | |
| 83-144 | NTIS (US Sales Only), PC A02/MF A01 | DE84703220 | MN -34D | 10:7626 |
| **IHZ-WK-** | | | | |
| 81-380 | NTIS (US Sales Only), PC A09/MF A01 | DE85780209 | MN -78 | 10:6747 |
| **IIASA-RR-** | | | | |
| 83-9 | International Inst. for Applied Systems Analysis, Laxenburg, Austria | | | 10:6904 |
| **IKE-** | | | | |
| 4-116 | NTIS (US Sales Only), PC A09/MF A01 | DE85750566 | MN -13 | 10:6902 |
| **ILE-** | | | | |
| 8302G | NTIS (US Sales Only), PC A02/MF A01 | DE85700121 | MN -20 | 10:8002 |
| 8303P | NTIS (US Sales Only), PC A02/MF A01 | DE85700122 | MN -20 | 10:8003 |
| **INDC(FR)-** | | | | |
| 56-L | *See* NEANDC(E)-228-L | DE85700149 | MN -34C | 10:7823 |

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| **INER-** | | | | |
| 0474 | NTIS (US Sales Only), PC A03/MF A01; 1 | DE85900137 | MN -78 | 10:6785 |
| **INFN/AE-** | | | | |
| 83-1 | NTIS (US Sales Only), PC A02/MF A01 | DE85700097 | MN -34D | 10:7905 |
| 83-2 | NTIS (US Sales Only), PC A02/MF A01 | DE85700129 | MN -34D | 10:7627 |
| **INFN/BE-** | | | | |
| 83-1 | NTIS (US Sales Only), PC A02/MF A01 | DE85700146 | MN -34C | 10:7708 |
| 83-8 | NTIS (US Sales Only), PC A03/MF A01 | DE85700147 | MN -34C | 10:7832 |
| **INIS-mf-** | | | | |
| 9071 | NTIS (US Sales Only), PC A04/MF A01 | DE85780132 | MN -4 | 10:7485 |
| 9073 | NTIS (US Sales Only), PC A02/MF A01 | DE85780130 | MN -34C | 10:7345 |
| 9074 | NTIS (US Sales Only), PC A03/MF A01 | DE85780127 | MN -34C | 10:7833 |
| 9075 | NTIS (US Sales Only), PC A02/MF A01 | DE85780124 | MN -34A | 10:7573 |
| 9079 | NTIS (US Sales Only), PC A04/MF A01 | DE85780134 | MN -51 | 10:6528 |
| 9080 | NTIS (US Sales Only), PC A04/MF A01 | DE85780149 | MN -2 | 10:6462 |
| 9081 | NTIS (US Sales Only), PC A02/MF A01 | DE85780141 | MN -28 | 10:7324 |
| 9082 | NTIS (US Sales Only), PC A08/MF A01 | DE85780128 | MN -34C | 10:7308 |
| 9083 | NTIS (US Sales Only), PC A05/MF A01 | DE85780131 | MN -34C | 10:7700 |
| 9084 | NTIS (US Sales Only), PC A06/MF A01 | DE85780125 | MN -34D | 10:7701 |
| 9085 | NTIS (US Sales Only), PC A03/MF A01 | DE85780150 | MN -13 | 10:7420 |
| 9086 | NTIS (US Sales Only), PC A08/MF A01 | DE85780145 | MN -2 | 10:6924 |
| 9087 | NTIS (US Sales Only), PC A02/MF A01 | DE85780133 | MN -4 | 10:7544 |
| 9088 | NTIS (US Sales Only), PC A07/MF A01 | DE85780140 | MN -71 | 10:6443 |
| 9089 | NTIS (US Sales Only), PC A05/MF A01 | DE85780152 | MN -2 | 10:7486 |
| 9090 | NTIS (US Sales Only), PC A02/MF A01 | DE85780144 | MN -37 | 10:7886 |
| 9091 | NTIS (US Sales Only), PC A08/MF A01 | DE85780139 | MN -23 | 10:7888 |
| 9092 | NTIS (US Sales Only), PC A03/MF A01 | DE85780146 | MN -2 | 10:7043 |
| 9093 | NTIS (US Sales Only), PC A04/MF A01 | DE85780142 | MN -25 | 10:7289 |
| 9094 | NTIS (US Sales Only), PC A04/MF A01 | DE85780135 | MN -11 | 10:7557 |
| 9098 | NTIS (US Sales Only), PC A08/MF A01 | DE85780156 | MN -20 | 10:7071 |
| 9099 | NTIS (US Sales Only), PC A02/MF A01 | DE85780181 | MN -70 | 10:6486 |
| 9100 | NTIS (US Sales Only), PC A02/MF A01 | DE85780158 | MN -86 | 10:6444 |
| 9117 | NTIS (US Sales Only), PC A07/MF A01 | DE85780136 | MN -11 | 10:7545 |
| 9119 | NTIS (US Sales Only), PC A07/MF A01 | DE85780138 | MN -48 | 10:7446 |
| 9122 | NTIS (US Sales Only), PC A11/MF A01 | DE85780137 | MN -48 | 10:8103 |
| 9124 | NTIS (US Sales Only), PC A08/MF A01 | DE85780143 | MN -25 | 10:7290 |
| 9125 | NTIS (US Sales Only), PC A02/MF A01 | DE85780126 | MN -34D | 10:7628 |
| 9156 | NTIS (US Sales Only), PC A03/MF A01 | DE85780172 | MN -48 | 10:7448 |
| 9157 | NTIS (US Sales Only), PC A24/MF A01 | DE85780151 | MN -2 | 10:6757 |
| 9158 | NTIS (US Sales Only), PC A04/MF A01 | DE85780173 | MN -48 | 10:7449 |
| 9159 | NTIS (US Sales Only), PC A05/MF A01 | DE85780162 | MN -23 | 10:7247 |
| 9160 | NTIS (US Sales Only), PC A10/MF A01 | DE85780159 | MN -25 | 10:7088 |
| 9162 | NTIS (US Sales Only), PC A07/MF A01 | DE85780157 | MN -46 | 10:7868 |
| 9163 | NTIS (US Sales Only), PC A02/MF A01 | DE85780182 | MN -2 | 10:6787 |
| 9164 | NTIS (US Sales Only), PC A06/MF A01 | DE85780179 | MN -71 | 10:7089 |
| 9165 | NTIS (US Sales Only), PC A05/MF A01 | DE85780164 | MN -48 | 10:7450 |
| 9166 | NTIS (US Sales Only), PC A05/MF A01 | DE85780174 | MN -48 | 10:7451 |
| 9167 | NTIS (US Sales Only), PC A04/MF A01 | DE85780165 | MN -48 | 10:7452 |
| 9168 | NTIS (US Sales Only), PC A06/MF A01 | DE85780166 | MN -48 | 10:7453 |
| 9170 | NTIS (US Sales Only), PC A06/MF A01 | DE85780175 | MN -48 | 10:7454 |
| 9171 | NTIS (US Sales Only), PC A03/MF A01 | DE85780176 | MN -48 | 10:7455 |
| 9172 | NTIS (US Sales Only), PC A06/MF A01 | DE85780177 | MN -48 | 10:7456 |
| 9173 | NTIS (US Sales Only), PC A07/MF A01 | DE85780167 | MN -48 | 10:7457 |
| 9174 | NTIS (US Sales Only), PC A07/MF A01 | DE85780160 | MN -48 | 10:7490 |
| 9175 | NTIS (US Sales Only), PC A04/MF A01 | DE85780168 | MN -48 | 10:7458 |
| 9176 | NTIS (US Sales Only), PC A05/MF A01 | DE85780178 | MN -48 | 10:7459 |
| 9177 | NTIS (US Sales Only), PC A04/MF A01 | DE85780169 | MN -48 | 10:7460 |
| 9178 | NTIS (US Sales Only), PC A05/MF A01 | DE85780170 | MN -48 | 10:7461 |
| 9179 | NTIS (US Sales Only), PC A06/MF A01 | DE85780161 | MN -48 | 10:7491 |
| 9180 | NTIS (US Sales Only), PC A08/MF A01 | DE85780171 | MN -48 | 10:7462 |
| 9181 | NTIS (US Sales Only), PC A06/MF A01 | DE85780163 | MN -23 | 10:7492 |
| 9182 | NTIS (US Sales Only), PC A07/MF A01 | DE85780180 | MN -80 | 10:6796 |
| 9183 | NTIS (US Sales Only), PC A04/MF A01 | DE85780193 | MN -2 | 10:6788 |
| 9184 | NTIS (US Sales Only), PC A02/MF A01 | DE85780129 | MN -34C | 10:7720 |
| 9190 | NTIS (US Sales Only), PC A04/MF A01 | DE85780148 | MN -2 | 10:6959 |
| 9401 | NTIS (US Sales Only), PC A02/MF A01 | DE85780183 | MN -2 | 10:6946 |
| 9402 | NTIS (US Sales Only), PC A02/MF A01 | DE85780187 | MN -2 | 10:7889 |
| 9403 | NTIS (US Sales Only), PC A02/MF A01 | DE85780188 | MN -2 | 10:7890 |
| 9404 | NTIS (US Sales Only), PC A02/MF A01 | DE85780189 | MN -2 | 10:7493 |
| 9407 | NTIS (US Sales Only), PC A02/MF A01 | DE85780190 | MN -2 | 10:6537 |
| 9408 | NTIS (US Sales Only), PC A02/MF A01 | DE85780191 | MN -2 | 10:6538 |
| 9409 | NTIS (US Sales Only), PC A02/MF A01 | DE85780184 | MN -2 | 10:7891 |
| 9410 | NTIS (US Sales Only), PC A02/MF A01 | DE85780185 | MN -2 | 10:7539 |
| 9411 | NTIS (US Sales Only), PC A03/MF A01 | DE85780192 | MN -2 | 10:6855 |
| 9412 | NTIS (US Sales Only), PC A02/MF A01 | DE85780186 | MN -2 | 10:6948 |
| **INS-** | | | | |
| 462 | NTIS (US Sales Only), PC A02/MF A01 | DE84703234 | MN -34C | 10:7839 |
| 463 | NTIS (US Sales Only), PC A02/MF A01 | DE85700130 | MN -34D | 10:7630 |
| 465 | NTIS (US Sales Only), PC A02/MF A01 | DE84703226 | MN -34D | 10:7631 |
| 467 | NTIS (US Sales Only), PC A03/MF A01 | DE85700136 | MN -34C | 10:7840 |
| 468 | NTIS (US Sales Only), PC A02/MF A01 | DE85700140 | MN -34C | 10:7761 |
| 469 | NTIS (US Sales Only), PC A02/MF A01 | DE85700133 | MN -34D | 10:7687 |
| 471 | NTIS (US Sales Only), PC A02/MF A01 | DE85700141 | MN -34C | 10:7574 |
| 475 | NTIS (US Sales Only), PC A02/MF A01 | DE85700142 | MN -34C | 10:7841 |

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| 476 | NTIS (US Sales Only), PC A02/MF A01 | DE85700143 | MN -34C | 10:7714 |
| **INS-NUMA-** | | | | |
| 36 | NTIS (US Sales Only), PC A05/MF A01 | DE85780069 | MN -34C | 10:7703 |
| 37 | NTIS (US Sales Only), PC A08/MF A01 | DE85780070 | MN -34D | 10:7704 |
| **INS-PH-** | | | | |
| 2 | NTIS (US Sales Only), PC A07/MF A01 | DE85780071 | MN -34D | 10:7705 |
| **INTRON-** | | | | |
| 83210 | INTRON B.V., Maastricht, Netherlands | | | 10:6323 |
| 84083 | INTRON B.V., Maastricht, Netherlands | | | 10:6324 |
| **IPP-** | | | | |
| 1/ 222 | NTIS (US Sales Only), PC A04/MF A01 | DE84752315 | MN -20 | 10:7929 |
| 2/ 269 | NTIS (US Sales Only), PC A05/MF A01 | DE84752319 | MN -20 | 10:8008 |
| 2/ 271 | NTIS (US Sales Only), PC A04/MF A01 | DE84752318 | MN -20 | 10:8009 |
| 4/ 216 | NTIS (US Sales Only), PC A05/MF A01 | DE84752323 | MN -20 | 10:7930 |
| 6/ 219 | NTIS (US Sales Only), PC A02/MF A01 | DE84752308 | MN -34C | 10:7906 |
| 6/ 227 | NTIS (US Sales Only), PC A02/MF A01 | DE84752314 | MN -20 | 10:7931 |
| 6/ 229 | NTIS (US Sales Only), PC A03/MF A01 | DE84752313 | MN -20 | 10:7932 |
| 6/ 232 | NTIS (US Sales Only), PC A02/MF A01 | DE84752320 | MN -20 | 10:7933 |
| 6/ 234 | NTIS (US Sales Only), PC A03/MF A01 | DE84752288 | MN -20 | 10:7934 |
| III/ 69 | NTIS (US Sales Only), PC A02/MF A01 | DE84752317 | MN -20 | 10:7935 |
| III/ 87 | NTIS (US Sales Only), PC A02/MF A01 | DE84752316 | MN -20 | 10:7936 |
| III/ 90 | NTIS (US Sales Only), PC A03/MF A01 | DE84752321 | MN -20 | 10:7937 |
| III/ 91 | NTIS (US Sales Only), PC A02/MF A01 | DE84752287 | MN -20 | 10:7938 |
| III/ 95 | NTIS (US Sales Only), PC A02/MF A01 | DE84752322 | MN -20 | 10:7939 |
| **IPPJ-** | | | | |
| 603 | NTIS (US Sales Only), PC A02/MF A01 | DE84703200 | MN -20 | 10:7959 |
| 606 | NTIS (US Sales Only), PC A03/MF A01 | DE84703210 | MN -20 | 10:8021 |
| 607 | NTIS (US Sales Only), PC A03/MF A01 | DE84703211 | MN -20 | 10:8022 |
| 612 | NTIS (US Sales Only), PC A04/MF A01 | DE84703217 | MN -20 | 10:7960 |
| 613 | NTIS (US Sales Only), PC A02/MF A01 | DE84703197 | MN -20 | 10:7961 |
| 616 | NTIS (US Sales Only), PC A04/MF A01 | DE84703206 | MN -20 | 10:8023 |
| 617 | NTIS (US Sales Only), PC A02/MF A01 | DE84703213 | MN -20 | 10:8024 |
| 618 | NTIS (US Sales Only), PC A02/MF A01 | DE84703207 | MN -20 | 10:8025 |
| 619 | NTIS (US Sales Only), PC A03/MF A01 | DE84703198 | MN -20 | 10:7962 |
| 620 | NTIS (US Sales Only), PC A02/MF A01 | DE84703203 | MN -20 | 10:7963 |
| 621 | NTIS (US Sales Only), PC A02/MF A01 | DE85700105 | MN -20 | 10:7964 |
| 622 | NTIS (US Sales Only), PC A03/MF A01 | DE84703201 | MN -20 | 10:7965 |
| 623 | NTIS (US Sales Only), PC A04/MF A01 | DE85700116 | MN -20 | 10:8026 |
| 624 | NTIS (US Sales Only), PC A02/MF A01 | DE85700110 | MN -20 | 10:7966 |
| 625 | NTIS (US Sales Only), PC A02/MF A01 | DE85700120 | MN -20 | 10:8027 |
| 626 | NTIS (US Sales Only), PC A03/MF A01 | DE85700106 | MN -20 | 10:7967 |
| 627 | NTIS (US Sales Only), PC A02/MF A01 | DE85700123 | MN -20 | 10:8028 |
| 628 | NTIS (US Sales Only), PC A02/MF A01 | DE85700107 | MN -20 | 10:7968 |
| 629 | NTIS (US Sales Only), PC A03/MF A01 | DE85700108 | MN -20 | 10:7969 |
| 630 | NTIS (US Sales Only), PC A09/MF A01 | DE85700111 | MN -20 | 10:7970 |
| 631 | NTIS (US Sales Only), PC A03/MF A01 | DE85700109 | MN -20 | 10:7971 |
| 633 | NTIS (US Sales Only), PC A03/MF A01 | DE85700112 | MN -20 | 10:7972 |
| 634 | NTIS (US Sales Only), PC A03/MF A01 | DE85700113 | MN -20 | 10:7973 |
| 635 | NTIS (US Sales Only), PC A02/MF A01 | DE85700114 | MN -20 | 10:7974 |
| 636 | NTIS (US Sales Only), PC A02/MF A01 | DE85700124 | MN -20 | 10:8029 |
| 637 | NTIS (US Sales Only), PC A02/MF A01 | DE85700125 | MN -20 | 10:8030 |
| 638 | NTIS (US Sales Only), PC A03/MF A01 | DE85700115 | MN -20 | 10:7975 |
| **IPPJ-DT-** | | | | |
| 100 | NTIS (US Sales Only), PC A03/MF A01 | DE84703212 | MN -20 | 10:8031 |
| **IS-M-** | | | | |
| 528 | NTIS, PC A02/MF A01 (GPO Dep.) | DE85003081 | MN -25 | 10:7291 |
| **ISPO-** | | | | |
| 225 | *See* PNL-5257 | DE85003661 | MN -15 | 10:6539 |
| **ITEF-** | | | | |
| 109(1983) | NTIS (US Sales Only), PC A03/MF A01 | DE85700126 | MN -34B | 10:7558 |
| 143(1983) | NTIS (US Sales Only), PC A02/MF A01 | DE84703227 | MN -34D | 10:7632 |
| **JAERI-** | | | | |
| 1284 | NTIS (US Sales Only), PC A04/MF A01 | DE84703218 | MN -20 | 10:8032 |
| **JAERI-M-** | | | | |
| 83-031 | NTIS (US Sales Only), PC A08/MF A01 | DE84703204 | MN -20 | 10:8033 |
| 83-058 | NTIS (US Sales Only), PC A05/MF A01 | DE84703208 | MN -20 | 10:8037 |
| 83-059 | NTIS (US Sales Only), PC A03/MF A01 | DE84703215 | MN -20 | 10:8038 |
| 83-069 | NTIS (US Sales Only), PC A03/MF A01 | DE84703214 | MN -20 | 10:8039 |
| 83-077 | NTIS (US Sales Only), PC A03/MF A01 | DE84703216 | MN -20 | 10:8040 |
| 83-085 | NTIS (US Sales Only), PC A03/MF A01 | DE84703202 | MN -20 | 10:7976 |
| 83-087 | NTIS (US Sales Only), PC A02/MF A01 | DE84703209 | MN -20 | 10:8041 |
| 83-102 | NTIS (US Sales Only), PC A04/MF A01 | DE84703205 | MN -20 | 10:8042 |
| 83-141 | NTIS (US Sales Only), PC A02/MF A01 | DE84703199 | MN -20 | 10:7977 |
| 83-182 | NTIS (US Sales Only), PC A11/MF A01 | DE85700103 | MN -20 | 10:7923 |
| 83-213 | NTIS (US Sales Only), PC A99/MF A01 | DE85700117 | MN -20 | 10:8043 |
| 83-214 | NTIS (US Sales Only), PC A99/MF A01 | DE85700118 | MN -20 | 10:8044 |
| 83-215 | NTIS (US Sales Only), PC A99/MF A01 | DE85700119 | MN -20 | 10:8045 |
| **JINR-** | | | | |
| E-2-83-863 | NTIS (US Sales Only), PC A02/MF A01 | DE84703221 | MN -34D | 10:7633 |
| R-1-83-832 | NTIS (US Sales Only), PC A02/MF A01 | DE84703222 | MN -34D | 10:7634 |
| R-2-83-508 | NTIS (US Sales Only), PC A02/MF A01 | DE84703223 | MN -34D | 10:7635 |
| R-6-83-518 | NTIS (US Sales Only), PC A03/MF A01 | DE84703232 | MN -34C | 10:7842 |
| **JINR-R-** | | | | |
| 1-83-733 | NTIS (US Sales Only), PC A02/MF A01 | DE85700148 | MN -34C | 10:7799 |

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| **JPL-PUB-** | | | | |
| 84-14 | *See* DOE/CS/54209-15 | DE85004585 | STD -96 | 10:7068 |
| 84-47 | *See* DOE/JPL/1012-99 | DE85003481 | STD -63b | 10:6569 |
| **Juel-** | | | | |
| 1885 | NTIS (US Sales Only), PC A03/MF A01 | DE84752310 | MN -20 | 10:8046 |
| 1898 | NTIS (US Sales Only), PC A03/MF A01 | DE84752286 | MN -20 | 10:7978 |
| 1902 | NTIS (US Sales Only), PC A08/MF A01 | DE84752330 | MN -80 | 10:6763 |
| 1909 | NTIS (US Sales Only), PC A03/MF A01 | DE84752302 | MN -20 | 10:7979 |
| 1911 | NTIS (US Sales Only), PC A06/MF A01 | DE84752303 | MN -38 | 10:7261 |
| **Juel-Spez-** | | | | |
| 247 | NTIS (US Sales Only), PC A03/MF A01 | DE84752290 | MN -83 | 10:6445 |
| 255 | NTIS (US Sales Only), PC A09/MF A01 | DE85750011 | MN -34C | 10:7707 |
| **KEK-** | | | | |
| 82-8 | NTIS (US Sales Only), PC A05/MF A01 | DE85780011 | MN -34C | 10:7611 |
| **KFK-** | | | | |
| 3348 | NTIS (US Sales Only), PC A08/MF A01 | DE84752294 | MN -38 | 10:7281 |
| 3565 | NTIS (US Sales Only), PC A05/MF A01 | DE84752331 | MN -11 | 10:7363 |
| 3632 | NTIS (US Sales Only), PC A05/MF A01 | DE84752328 | MN -79 | 10:6769 |
| 3634 | NTIS (US Sales Only), PC A03/MF A01 | DE84752332 | MN -86 | 10:6446 |
| 3689 | NTIS (US Sales Only), PC A02/MF A01 | DE84752300 | MN -22 | 10:6430 |
| 3711 | *See* BMI-1984-041 | DE84752334 | MN -78 | 10:6797 |
| 3715 | NTIS (US Sales Only), PC A06/MF A01 | DE84752291 | MN -11 | 10:7390 |
| 3718 | NTIS (US Sales Only), PC A04/MF A01 | DE84752339 | MN -28 | 10:7329 |
| 3721 | NTIS (US Sales Only), PC A03/MF A01 | DE84752305 | MN -25 | 10:7093 |
| 3722 | NTIS (US Sales Only), PC A05/MF A01 | DE84752324 | MN -34 | 10:7898 |
| 3723 | NTIS (US Sales Only), PC A06/MF A01 | DE84752306 | MN -25 | 10:7094 |
| 3734 | NTIS (US Sales Only), PC A06/MF A01 | DE84752289 | MN -34C | 10:7349 |
| 3743 | NTIS (US Sales Only), PC A07/MF A01 | DE84752325 | MN -38 | 10:7282 |
| 3755 | NTIS (US Sales Only), PC A03/MF A01 | DE84752309 | MN -20 | 10:8050 |
| 3758 | NTIS (US Sales Only), PC A02/MF A01 | DE84752338 | MN -34D | 10:7612 |
| **KFKI-** | | | | |
| 1983-110 | NTIS (US Sales Only), PC A03/MF A01 | DE84703183 | MN -34D | 10:7909 |
| 1984-25 | NTIS (US Sales Only), PC A02/MF A01 | DE85700144 | MN -34C | 10:7580 |
| **KIYI-** | | | | |
| 83-19 | NTIS (US Sales Only), PC A03/MF A01 | DE84703233 | MN -34C | 10:7791 |
| **KURRI-TR-** | | | | |
| 231 | NTIS (US Sales Only), PC A04/MF A01 | DE84703195 | MN -34A | 10:7095 |
| **LA-** | | | | |
| 10032-PR | NTIS, PC A05/MF A01 (GPO Dep.) | DE85002303 | STD -70 | 10:6487 |
| **LA-tr-** | | | | |
| 84-47 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | DE85000251 | MN -92a | 10:7358 |
| **LA-UR-** | | | | |
| 84-392 | NTIS, PC A02/MF A01 (GPO Dep.) | DE84009611 | MN -45 | 10:7299 |
| 84-2749 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | DE84016777 | MN -38 | 10:7273 |
| 84-3068 | NTIS, PC A02/MF A01 (GPO Dep.) | DE85000658 | MN -34B | 10:8088 |
| 84-3173 | NTIS, PC A03/MF A01 (GPO Dep.) | DE85002206 | MN -34 | 10:7263 |
| 84-3330 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | DE85002414 | MN -34B | 10:7560 |
| 84-3353 | NTIS, PC A02; 3 | DE85002389 | MN -41 | 10:7391 |
| 84-3388 | NTIS, PC A02/MF A01 (GPO Dep.) | DE85002411 | MN -33 | 10:6774 |
| 84-3390 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | DE85002379 | MN -41 | 10:7392 |
| 84-3428 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | DE85002432 | MN -32 | 10:8089 |
| 84-3440 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | DE85002433 | MN -33 | 10:6806 |
| 84-3447 | NTIS, PC A02/MF A01 (GPO Dep.) | DE85002434 | MN -11 | 10:7364 |
| 84-3469 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | DE85003745 | MN -34B | 10:7561 |
| 84-3487 | NTIS, PC A02/MF A01 (GPO Dep.) | DE85003754 | MN -25 | 10:7096 |
| 84-3488 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | DE85003725 | MN -4 | 10:7097 |
| 84-3497 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | DE85003743 | MN -25 | 10:7098 |
| **LBL-** | | | | |
| 16362 | NTIS, PC A04/MF A01; 1 (GPO Dep.) | DE85003454 | MN -95d | 10:6987 |
| 17173 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | DE84012254 | MN -95d | 10:6988 |
| 17459 | NTIS, PC A03/MF A01 (GPO Dep.) | DE84016948 | MN -95d | 10:6989 |
| 17781 | NTIS, PC A02; 3 | DE85003468 | MN -48 | 10:7463 |
| 17996-Rev. | NTIS, PC A02/MF A01 (GPO Dep.) | DE85002900 | MN -28 | 10:7330 |
| 18008 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | DE85003457 | MN -20 | 10:8052 |
| 18016 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | DE85003456 | MN -20 | 10:8053 |
| 18149 | NTIS, PC A03/MF A01 (GPO Dep.) | DE84016951 | MN -95d | 10:6990 |
| 18250 | NTIS, PC A05/MF A01; 1 (GPO Dep.) | DE85004340 | MN -70 | 10:6518 |
| 18402 | NTIS, PC A02/MF A01 (GPO Dep.) | DE85003470 | MN -28 | 10:7662 |
| 18413 | NTIS, PC A05/MF A01 (GPO Dep.) | DE85003042 | STD -94c | 10:6897 |
| 18424 | NTIS, PC A03; 3 | DE85000597 | MN -34D | 10:7613 |
| 18425 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | DE85004346 | STD -95c | 10:7035 |
| 18473 | NTIS, PC A04/MF A01; 1 (GPO Dep.) | DE85004445 | STD -70 | 10:6488 |
| 18501 | NTIS, PC A02/MF A01 (GPO Dep.) | DE85003471 | MN -28 | 10:7331 |
| 18530 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | DE85003459 | MN -20 | 10:8054 |
| 18554 | NTIS, PC A09/MF A01; 1 (GPO Dep.) | DE85003473 | MN -25 | 10:7163 |
| 18569 | NTIS, PC A07/MF A01; 1 (GPO Dep.) | DE85003458 | MN -4 | 10:7910 |
| 18582 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | DE85003469 | MN -4 | 10:7099 |
| 18634 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | DE85004447 | STD -32 | 10:7920 |
| 18700 | NTIS, PC A05/MF A01; 1 (GPO Dep.) | DE85003472 | MN -48 | 10:7442 |
| **LBL-PUB-** | | | | |
| 468 | NTIS, PC A03/MF A01 (GPO Dep.) | DE85003455 | MN -13 | 10:8081 |
| **MIT/BNL-** | | | | |
| 83-1 | *See* BNL-51816 | DE85004566 | STD -25 | 10:7077 |

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|---|---|---|---|---|
| **MLM-** | | | | |
| 3192(OP) | NTIS, PC A02/MF A01; 1 (GPO Dep.) | DE85003309 | MN -25 | 10:7140 |
| 3199 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | DE85004450 | STD -4 | 10:7141 |
| 3200 | NTIS, PC A02/MF A01 (GPO Dep.) | DE85003714 | STD -4 | 10:7100 |
| 3217(OP) | NTIS, PC A02; 3 | DE85003304 | MN -11 | 10:7540 |
| 3218(OP) | NTIS, PC A02/MF A01; 1 (GPO Dep.) | DE85003305 | MN -70A | 10:6529 |
| 3219(OP) | NTIS, PC A03/MF A01; 1 (GPO Dep.) | DE85003303 | MN -25 | 10:7142 |
| **MPI-PAE/Exp.El.-** | | | | |
| 128 | NTIS (US Sales Only), PC A02/MF A01 | DE84752304 | MN -34D | 10:7614 |
| **MTI-** | | | | |
| 84FPSE23 | *See* PB-84-237767 | | | 10:7009 |
| **NASA-CR-** | | | | |
| 174753 | *See* DOE/NASA-0238-1 | DE85003071 | STD -97d | 10:6965 |
| 174764 | *See* DOE/NASA-0330-1 | DE85003054 | STD -60 | 10:6730 |
| **NASA-TM-** | | | | |
| 86901 | *See* DOE/NASA/50194-41 | DE85003887 | STD -96 | 10:7061 |
| **NBS/SP-** | | | | |
| 446-8 | *See* PB-84-222249 | | | 10:7000 |
| **NBS-TN-** | | | | |
| 1196 | NTIS, PC A08/MF A01; 1 (GPO Dep.) | DE85003489 | STD -59a | 10:6639 |
| **NBSIR-** | | | | |
| 84-2887 | NTIS, PC A04/MF A01 (GPO Dep.) | DE85002598 | MN -59a | 10:6640 |
| 84/ 2890 | *See* PB-84-218064 | | | 10:6998 |
| 84-2906 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | DE85003065 | MN -95d | 10:6991 |
| 84-2942 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | DE85003249 | STD -59b | 10:6655 |
| **NCEL-TN-** | | | | |
| 1696 | *See* AD-A-143402/6 | | | 10:6962 |
| **NEANDC(E)-** | | | | |
| 228-L | NTIS (US Sales Only), PC A06/MF A01 | DE85700149 | MN -34C | 10:7823 |
| **NIRS-M-** | | | | |
| 38 | NTIS (US Sales Only), PC A13/MF A01 | DE85780072 | MN -4 | 10:7464 |
| **NIRS-RSD-** | | | | |
| 59 | NTIS (US Sales Only), PC A03/MF A01 | DE85780155 | MN -11 | 10:7394 |
| **NLCO-** | | | | |
| 2021 | NTIS, PC A02/MF A01 (GPO Dep.) | DE85003484 | MN -47 | 10:6530 |
| 2022 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | DE85002193 | MN -10 | 10:6429 |
| **NMAB-** | | | | |
| 418 | National Research Council, 2101 Constitution Ave., Washington, DC 20418 | TI85900389 | MN -25 | 10:6920 |
| **NP-** | | | | |
| 4901545 | GPO* | TI84901545 | MN -11 | 10:7423 |
| 5770074 | NTIS (US Sales Only), PC A09/MF A01 | DE85770074 | MN -61d | 10:6921 |
| 5770077 | NTIS (US Sales Only), PC A11/MF A01; 1 | DE85770077 | MN -95d | 10:6992 |
| 5770078 | NTIS (US Sales Only), PC A07/MF A01; 1 | DE85770078 | MN -88 | 10:6339 |
| 5770079 | NTIS (US Sales Only), PC A03/MF A01; 1 | DE85770079 | MN -96 | 10:7062 |
| 5770080 | NTIS (US Sales Only), PC A11/MF A01; 1 | DE85770080 | MN -98F | 10:6905 |
| 5770081 | NTIS (US Sales Only), PC A04/MF A01; 1 | DE85770081 | MN -13 | 10:6922 |
| 5770082 | NTIS (US Sales Only), PC A02/MF A01; 1 | DE85770082 | MN -63 | 10:6570 |
| 5770083 | NTIS (US Sales Only), PC A03/MF A01; 1 | DE85770083 | MN -88 | 10:6340 |
| 5770084 | NTIS (US Sales Only), PC A03/MF A01; 1 | DE85770084 | MN -92a | 10:6388 |
| 5770085 | NTIS (US Sales Only), PC A05/MF A01; 1 | DE85770085 | MN -88 | 10:6353 |
| 5770086 | NTIS (US Sales Only), PC A04/MF A01; 1 | DE85770086 | MN -88 | 10:6337 |
| 5770087 | NTIS (US Sales Only), PC A04/MF A01; 1 | DE85770087 | MN -88 | 10:6354 |
| 5770088 | NTIS (US Sales Only), PC A03/MF A01; 1 | DE85770088 | MN -96 | 10:7063 |
| 5770089 | NTIS (US Sales Only), PC A02/MF A01; 1 | DE85770089 | MN -95d | 10:6993 |
| 5770090 | NTIS (US Sales Only), PC A03/MF A01; 1 | DE85770090 | MN -11 | 10:7529 |
| 5770091 | NTIS (US Sales Only), PC A08/MF A01; 1 | DE85770091 | MN -38 | 10:7283 |
| 5770093 | NTIS (US Sales Only), PC A03/MF A01; 1 | DE85770093 | MN -96 | 10:7064 |
| 5770094 | NTIS (US Sales Only), PC A04; 3 | DE85770094 | MN -13 | 10:6914 |
| 5770096 | NTIS (US Sales Only), PC A06/MF A01; 1 | DE85770096 | MN -13 | 10:6254 |
| 5770107 | NTIS (US Sales Only), PC A10/MF A01;1 | DE85770107 | MN -11 | 10:7550 |
| 5770108 | NTIS (US Sales Only), PC A03/MF A01 | DE85770108 | MN -98B | 10:6949 |
| 5770109 | NTIS (US Sales Only), PC A08/MF A01; 1 | DE85770109 | MN -66 | 10:6690 |
| 5770110 | NTIS (US Sales Only), PC A08/MF A01; 1 | DE85770110 | MN -48 | 10:7387 |
| 5770111 | NTIS (US Sales Only), PC A04/MF A01 | DE85770111 | MN -98C | 10:6950 |
| 5900007 | Massachusetts Inst. of Tech., 50 Memorial Drive, Cambridge, MA 02139 | TI85900007 | MN -95 | 10:6906 |
| 5900016 | NTIS (US Sales Only), PC A06/MF A01; 1 | DE85900016 | MN -59a | 10:6619 |
| 5900018 | NTIS (US Sales Only), PC A06/MF A01 | DE85900018 | MN -59a | 10:6620 |
| 5900019 | NTIS (US Sales Only), PC A05/MF A01; 1 | DE85900019 | MN -59a | 10:6621 |
| 5900020 | NTIS (US Sales Only), PC A06; 3 | DE85900020 | MN -59a | 10:6564 |
| 5900061 | NTIS (US Sales Only), PC A09/MF A01; 1 | DE85900061 | MN -59a | 10:6622 |
| 5900101 | NTIS (US Sales Only), PC A09/MF A01; 1 | DE85900101 | MN -59a | 10:6656 |
| 5900102 | NTIS (US Sales Only), PC A08/MF A01; 1 | DE85900102 | MN -59a | 10:6623 |
| 5900129 | NTIS (US Sales Only), MF A01; 2 | DE85900129 | MN -59a | 10:6624 |
| 5900160 | NTIS, PC A05; 3 | DE85900160 | MN -4 | 10:7203 |
| 5900202 | NTIS (US Sales Only), PC A03/MF A01; 1 | DE85900202 | MN -97 | 10:6907 |
| 5900314 | Interstate Oil Compact Comm., Box 53127, Oklahoma City, Oklahoma 73152 | TI85900314 | MN -92 | 10:6389 |
| 5900352 | Marine Sciences Research Center, State Univ. of New York, Stony Brook, NY 11794 | TI85900352 | MN -78 | 10:7415 |
| 5900362 | Salomon Brothers Inc., Stock Research, One New York Plaza, New York, NY 10004 | TI85900362 | ND -92 | 10:6390 |

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|---|---|---|---|---|
| 5900364 | Salomon Brothers Inc., One New York Plaza, New York, NY 10004 | TI85900364 | ND -92 | 10:6391 |
| 5900373 | NTIS, PC A02/MF A01 | DE85900373 | MN -98 | 10:6951 |
| 5900393 | Governors Energy Office, The Capital, Tallahassee, FL 32301 | TI85900393 | MN -66 | 10:6668 |
| 5900394 | The Governor's Energy Office, The Capital, Tallahassee, FL 32301 | TI85900394 | MN -61a | 10:6560 |
| 5900395 | Governors Energy Office, The Capital, Tallahassee, FL 32301 | TI85900395 | MN -60 | 10:6731 |
| 5900396 | Governor's Energy Office, The Capital, Tallahassee, FL 32301 | TI85900396 | MN -61 | 10:6961 |
| **NR-** | | | | |
| 83-10 | Nijverheidsorganisatie TNO, Hoofdgroep Maatschappelijke Technologie, Apeldoorn, Netherlands | | | 10:6298 |
| **NUREG-** | | | | |
| 0090-Vol.7-No.2 | NTIS, PC A03/MF A01 - GPO* | TI85900351 | MN -78 | 10:6856 |
| 0304-Vol.9-No.3 | NTIS, PC A07/MF A01 - GPO* | TI85900287 | MN -80 | 10:6857 |
| 0383-Vol.2-Rev.7 | NTIS, PC A99/MF A01 - GPO* $11.00 | TI85900412 | MN -71 | 10:6459 |
| 0748-Vol.4-No.9 | NTIS, PC A18/MF A01 - GPO* | TI85900361 | MN -78 | 10:6775 |
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| 0750-Vol.20-No.1 | NTIS, PC A12/MF A01 - GPO* | TI85900411 | MN -2 | 10:6777 |
| 0837-Vol.4-No.1 | NTIS, PC A07 - GPO* | TI85900354 | MN -78 | 10:6858 |
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| 6054 | NTIS, PC A04/MF A01; 1 (GPO Dep.) | DE85003797 | STD -32 | 10:7255 |
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| 9092 | NTIS, PC A12/MF A01; 1 (GPO Dep.) | DE85003816 | MN -11 | 10:7388 |
| 9115 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | DE85003812 | MN -90h | 10:7102 |
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UG Uganda
US United States of America (USA)
UY Uruguay

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VE Venezuela
VS Republic of Vietnam

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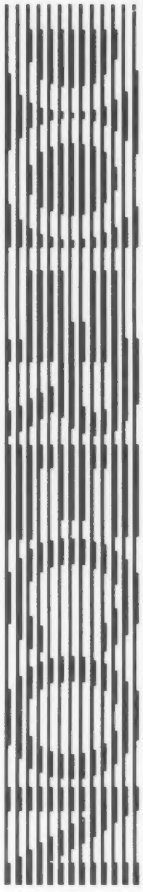

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